

### The Ultimate 'Task-Driven Independent Learning' Resource

for A Level Year 2 OCR Biology A

A van Kesteren

Update v1.1, June 2024

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### **Teacher's Introduction**

Thank you for choosing this A Level Independent Learning resource for Biology. This resource covers – and is cross-referenced to – the Biology OCR A specification for the second year A Level syllabus.

I know how difficult it is to set meaningful homework or cover work for A Level students that isn't non-directed independent study, or a pile of exam questions to answer. While both are important, often what is really needed is a more structured approach to revision which allows students to review existing knowledge and apply it to novel situations, rephrasing concepts to help them understand and develop their internal models of difficult concepts. This resource should provide you with exactly that: structured, guided questions and tasks that will consolidate, extend, challenge and support them.

There are 15 bespoke homeworks/lessons, each with:

- Learning objectives
- 'Getting going' tasks to start students off
- Background information and examples
- Main tasks
- 'Quick recap' plenaries to finish
- Extensions
- Answers

Each homework/lesson should last approximately one hour, but the extension tasks can take the content well beyond this duration for the speedy students, the brightest students and the longest lessons.

I hope your students enjoy using this resource, and that you find it a productive and effective option for task-driven independent study.

Best wishes and good luck to you and your students!

A van Kesteren, May 2023

### Update v1.1, June 2024:

Changes have been made to reflect the 2023 accessibility and clarity amendments to the specification.

The following questions (and associated answers) have been removed as they are no longer covered by the specification.

• Chapter 10, Task 4, Questions 1-2, pages 101-2 (and answers, page 202)

The following questions have been amended for clarity in matching the specification:

- Chapter 8, Task 4, page 81 (and answers, page 196) NADH corrected to reduced NAD
- Chapter 11, Task 7, page 119 (and answers, page 206) Chi-squared formula and notation updated

### **Lesson Summaries**

Lesson ID	Syllabus ref	esson title and learning objectives	Lesson outline and suggestions	Resources required
1	5.1.1a-c,	Homerasis	Getting going: Match the terms to their definions and	All tasks are to be answered on the
	5.1.4	• Define homeostasis	revise the structure of glycogen.	worksheet, but students may need a
		<ul> <li>Explain the terms negative feedback and</li> </ul>	Main: Four mixed tasks covering hormones, home sasis	sharp pencil and a ruler.
		posit / seedback	and negative feedback, in addition to the control	They may also need access to the
		Describe and explain the action of both steroid	glucose and diabetes.	Internet to research the final extension
		and process hormones	Quick recap: Decide if statements are true or false, a	task, but this could be done on a
		Describe an explain how blood glucose levels	correct the false ones.	smart device.
		are maint <sup>-</sup> id	<b>Extension</b> : Answer questions to describe and explain	
2	5.1.1d	Thormorogulatio	insulin signalling, positive feedback and release of insuli.	All tasks are to be answered on the
2	5.1.10	Thermoregulatio	<b>Getting going</b> : Define key terms and revision of enzyme activity with temperature.	worksheet, but students may need
		<ul> <li>Explain the reasons for maintaining temperature</li> <li>Define the terms endotherm and ectotherm</li> </ul>	Main: Three mixed tasks covering ectotherms, endotherms	a pencil.
			and examples of adaptations.	1 ey may also need access to the
		Describe the behavioural responses     of ectotherms	Quick recap: Answer the quick-fire questions.	rnet to research the final extension
		Describe and explain how endotherms	Extension: Produce a poster on thermoregulation.	but this could be done on a smart
		maintain their body to nperature		dev. e. In addition, they may require A3
		maintain their body to hiperature		or paper to complete the poster.
3	5.1.2	Excretion – the kidneys and the liver	Getting going: Complete a table to define key terms, and	All tasks are to be answered on the
		Describe the origin of excess amino acids	review the tests for the presence of proteins and	worksheet, but students will need a
		Describe the structure of a nephron	reducing sugars.	sharp pencil, a ruler and a calculator.
		Describe the processes of ultrafiltration and	Main: Four mixed tasks covering the structure and function	They may also need access to the
		selective reabsorption	of the parts of the nephron, and also osmoregulation.	Internet to research the final extension
		Explain how the countercurrent mechanism in	Quick recap: Decide if statements are true or false, and	task, but this could be done on a



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Lesson ID	Syllabus ref	Lesson title and learning objectives	Lesson outline and suggestions	Resources required
4	5.1.3, 5.1.5g-k	<ul> <li>The pus system and control of heart rate</li> <li>the events in a reflex arc</li> <li>cribe the structure of a motor neurone and state now it is specialised</li> <li>Compare and contrast the functions of the nerval system with the endocrine system</li> <li>Describe the events in the resting potential and acrati potential, and explain these events in term or ons</li> <li>Describe explain how an impulse is transmitted long a neurone, and explain why the speed of ferent in myelinated vs unmyelinated reurones</li> <li>Describe the events of synaptic transmission</li> <li>Describe how nemeart beat is initiated</li> <li>Describe and explain how the heart rate is increased or deceased</li> </ul>	Getting going: Draw a flow chart of the reflex complete a table summarising key terms.  Main: Seven mixed tasks covering the structuneurones and the nervous system, the role of recovers, the nervous impulse and synapses, in addition to control of heart rate.  Quick recap: Complete the crossword of key terms  Extension: Research the effects of drugs on the synapses.	All tasks are to be answered on the worksheet, and students may need a pencil and a ruler.  They may also need access to the Internet to research the final extension task, but this could be done on a smart device.
5	5.1.5a-f	Plant hormones  Define the term tropisin  Describe how plant hormones are able to initiate a response to stimuli  Use an example to show the complex action of plant hormones — apical dominance  Explain phototropism and geotropism	Getting going: Draw and label a plant cell.  Main: Three mixed tasks looking at the action of plant hormones, apical dominance, tropisms, and practical investigations.  Quick recap: Decide if the statements are true or false, and write correct versions for the false ones.  Extension: Research and summarise PIN proteins and the effect of some other plants hormones.	All tasks are to be answered on the worksneet, but students will need a sharp pencil, a ruler and a calculator.  They may also need access to the Internet to research the final extension task, but this could be done on a smart device.



Lesson ID	Syllabus ref	Lesson title and learning objectives	Lesson outline and suggestions	Resources required
7	5.2.1	<ul> <li>thesis</li> <li>the role of a pigment</li> <li>cribe how to separate different pigments from mixture</li> <li>Read the absorption of light to the rate of policy synthesis</li> <li>Describe the structure of a chloroplast and state victor process happens where</li> <li>Describe and explain the steps in the light-dependent fraction</li> <li>Explain the rack between the two stages</li> <li>Describe the responsible to the calvin cycle, and explain the calvin cycle, and explain the calvin how to measure the rate of photosynth sis</li> <li>Explain the effects of limiting factors on the rate of photosynthesis</li> </ul>	Getting going: Draw and label a chloroplast, a call the equation for photosynthesis.  Main: Six mixed tasks covering pigments (incomplete the light-dependent and light-independent stages and limiting factors, in additions how to measure the rate of photosynthesis.  Quick recap: Complete the table of definitions.  Extension: Compare and contrast photosynthesis and respiration, and research endosymbiotic theory.	All tasks are to be answered on the worksheet, but students will need a sharp pencil, a ruler and a calculator. They may also need access to the Internet to research the final extension task, but this could be done on a smart device.
8	5.2.2	Respiration     Describe the structure of ATP, and explain its function     Describe the stages of aerobic respiration including glycolysis, the link reaction, the Krebs cycle and oxidative phosphorylation     State the products of each stage     Explain the importance of coenzymes with	Getting going: Label a diagram of ATP, and match the terms to their definitions.  Main: Six mixed tasks covering the structure of mitochondria, the stages of aerobic respiration (glycolysis, the link reaction, the Krebs cycle and oxidative phosphorylation), plus anaerobic respiration and investigations into respiration rate.  Quick recap: Fill in the gaps to summarise the key terms.	All was ks are to be answered on the worksneet, but students will need a sharp pencil and a ruler.  They may also need access to the Internet to research the final extension task, but this could be done on a smart device.



Lesson 10	Syllabus ref	Lesson title and learning objectives	Lesson outline and suggestions	Resources required
9	6.1.1ab	<ul> <li>Stem mutations and gene expression</li> <li>the term stem cell and define the different types in cells</li> <li>Explain how a stem cell becomes a differ atiated cell</li> <li>Describe now induced pluripotent stem cells are crossed.</li> <li>Discuss is therapeutic uses of stem cells</li> <li>Define the term transcription factor</li> <li>Describe now transcription factors control gene expression</li> <li>Explain how are re expression can be altered by splicing</li> <li>Describe and a plain the lac operon as an example of control of gene expression</li> <li>Explain how me at ons occur and their effects on gene expression and, the afore, on the organism</li> </ul>	Getting going: Describe transcription in one sentence each.  Main: Four mixed tasks looking at starter, gene expression, the lac operon and mutations.  Quick recap: Fill in the gaps on stem cells and gene mutations.  Extension: Write a mini essay on the importance of stem cells.	All tasks are to be answered on the worksheet, but students may need extra paper for the extension.
10	6.1.1c-d, 6.2.1	<ul> <li>Body plans, cloning an intechnology</li> <li>Define the term body lan</li> <li>Describe and explain the role of mitosis and apoptosis in the development of the body plan</li> <li>Explain the genetic control of body plans with reference to homeobox genes</li> <li>Define the term clone</li> <li>Explain how cloning can be carried out artificially in plants and animals</li> </ul>	Getting going: Produce a mind map about cloning, and review the function of a transcription factor.  Main: Six mixed tasks covering body plans, cloning in plants and animals, biotechnology (including how to culture microorganisms) and immobilised enzymes.  Quick recap: Define the key terms.  Extension: Produce a poster advertising the products that can be made from mycoprotein.	All tasks are to be answered on the orksheet, and students will require a pencil and a calculator. They may also need access to the Internet to research the final extension task, but this could be done on a smart device.



Lesson ID	Syllabus ref	Lesson title and learning objectives	Lesson outline and suggestions	Resources required
11	6.1.2a(ii), b, c	<ul> <li>Inherit</li> <li>Little peterms chromosome, gene, allele, geterme, pe, phenotype</li> <li>Predictione outcome of monohybrid crosses involve dominant and recessive traits as well as codom to the traits and sex-linked traits</li> <li>Prediction outcomes of dihybrid crosses</li> <li>Explain the sults of a cross involving autosomal linkage and existasis</li> <li>Interpret pedical ee diagrams</li> <li>Use a chi-squared calculation and interpret the results</li> </ul>	Getting going: Match the keywords to their domain.  Main: Seven mixed tasks covering inheritant monohybrid, dihybrid, linkage, epistasis, pedia, and the chi-squared test.  Quick recap: Complete the table of definitions, and some quick genetic crosses.  Extension: Research other examples of the types of that have been encountered.	All tasks are to be answered on the worksheet, but students will need a sharp pencil, a ruler and a calculator. They may also need access to the Internet to research the final extension task, but this could be done on a smart device.
12	6.1.3	<ul> <li>Manipulating DNA</li> <li>Describe and explain how to clone a gene through the process of PCR</li> <li>Describe the role of restriction endonucleases</li> <li>Describe and explain for process of electrophoresis</li> <li>Explain how a DNA process works</li> <li>Describe and explain now to clone a gene using genetic engineering (in vivo gene cloning)</li> <li>Explain how a genetically engineered organism can express the gene it has been given</li> <li>Explain how amino acid sequences of a protein can be determined using a known sequence of DNA</li> </ul>	Getting going: Draw a nucleotide, and quick-fire questions on the structure of DNA.  Main: Four mixed tasks looking at PCR, electrophoresis, genetic fingerprinting, probes and in vivo gene cloning.  Quick recap: Complete the crossword of key terms.  Extension: Research the gene machine and GM soya beans.  Produce a poster on the pros and cons of genetic manipulation, and a mind map on the topics covered in this lesson.	All tasks are to be answered on the worksheet, but students may need a sharp pincil and a ruler. They may also need ess to the Internet, such as through a artphone, to access the extension task.



Lesson ID	Syllabus ref	Lesson title and learning objectives	Lesson outline and suggestions	Resources required
14	6.3.1d, 6.3.2a-b, 6.1.2d-g	<ul> <li>Population and evolution</li> <li>Single biotic and abiotic factors that affect the single population of organisms</li> <li>Describe and explain the relationship between predate and prey populations</li> <li>Explain if difference between interspecific competion and intraspecific competition</li> <li>Describe and explain the process of succession</li> <li>Calculate a letter frequency using the Hardy—Weinberg entries ion</li> <li>Explain how samples in allele frequency may occur over tingle ith reference to evolution</li> </ul>	Getting going: Match up the key terms.  Main: Five tasks covering population size, preserving population, succession, populationships, competition, succession, populationships, competition, succession, populationships, competition, succession, population, genetics (including the Hardy–Weinberg calculation), selection pressures, speciation and evolution.  Quick recap: Answer the quick-fire questions.  Extension: Research and summarise the difference; between different kinds of strategists. Research the difference between density-dependent and density-independent factors, finding examples of each.  Research an example of succession and use it to describe the process.	All tasks are to be answered on the worksheet, but students will need a sharp pencil, a ruler and a calculator. They may also need access to the Internet, such as through a smartphone, to access the extension tasks.
15	6.3.2d-e	<ul> <li>Describe the processes which transfer carbon in the carbon cycle</li> <li>Explain what has h phaned to the balance of these processes</li> <li>Describe the term clime a change</li> <li>Use data to explain the reasons for climate change</li> <li>Describe the reasons for conservation</li> <li>Describe the role of CITES</li> <li>Explain how ecosystems can be managed in a sustainable way, using examples</li> </ul>	Getting going: Answer the questions in the grid, then use the letters in the shaded squares to spell out a key term.  Main: Four mixed tasks covering climate change, conservation, sustainability and managing conflict.  Quick recap: Complete the crossword of key terms.  Extension: Produce a poster to show the effect of humans on the Galapagos Islands.	All tasks are to be answered on the worksheet, but students may also need A3 c A4 paper to complete the poster for extension task.  "ay may also need access to the Internet to crearch the final extension task, but this would be done on a smart device.



### Specification Reference Table

Lesson ID	OCR A ref	Le
1	5.1.1a-c, 5.1.4	Hor
2	5.1.1.d	Ther
3	5.1.2	Excretion – the
4	5.1.3, 5.1.5g-k	The nervous system
5	5.1.5a–f	Plant
6	5.1.5	Musc
7	5.2.1	Phot
8	5.2.2	Re
9	Ç (.1a- b	Stem cells, mutation
10	1.1c-d, 6.2.1	Body plans, clon
1.	6.1.2a(ii), b, c	In
12	6.1.3	Manip
13	6.3.1a-c, e	Measur
14	6.3.1d, 6.3.2a-b, 6.1.2d-g	Population
15	6.3.2d-e	Humans

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### 1. Homeostasis

### Learning objectives

By the end of this lesson, you should be able to:

- Define homeostasis
- Explain the terms negative feedback and positive feedback
- Describe and explain the action of both steroid and protein hormones
- Describe and explain how blood glucose levels are maintained

### Getting going

1. Match the hormone to the gland' has a winch it is released

1	Adrens"r
2	osterone
3	Insulin
4	Anti-diuretic hormone
5	Oestrogen
6	Thyroxine

Α	Testes	
В	Ovaries	
С	Adrenal glands	
D	Pancreas	
Е	Posterior pituitary	
F	Thyroid gland	

2.	Describe	the	structure	of	glycogen.

### The role of hormones

Hormones are produced in endocrine glands (they release the hormones defined they do not have ducts). The hormones travel in the it and to their target to response. The response will only be initiate in cell which contain the recommone. In this way, the endocrine in the far-reaching but ver Most hormones are made from a reads or proteins, and this difference in difference in the cites and pathway.

	19	A
	Tis	
Task	60,00	
	-	

### Hormones and homeostasis

1.	Define the term homeostasis.

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### Describe the difference between an endocrine gland and an exocrine glan 3. Synoptic – Name the structures in the cell surface membrane that are of the 4. Synoptic – Describe the structure of a protein. 5. What kind of molecule is a steroid? 6. Use the following paragraph to construct a flow diagram to explain how n The body is always working to try to keep the levels of various fa In order to do this the body has receptors which detect when a change is an increase, the communication systems of the body re the level of that factor back down. If this change is a decrease, work to bring the level back up again.

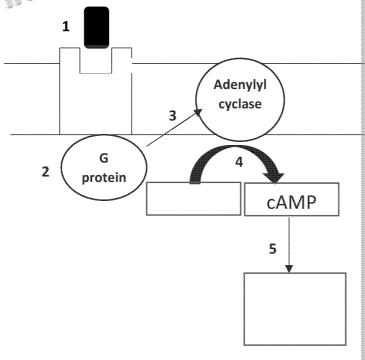
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### 7. Describe how positive feedback is different from negative feedback. Try the human body.

### Task 2 Methods of hormone action

1. The second messers of ten is used in many cells in order to respond to Describe when it is bearing at each numbered point.



1.		
	. 148	

2.	

3.	1888	y or	
•			

4.	

5.	

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2.	Order t	ne following stages to describe how a steroid hormone initiates a
		In the cytoplasm the hormone binds to a receptor
		Genes are turned on, and proteins are made through transcript
		The hormone passes through the cell membrane
		The complex now acts as a transcription factor
		The hormone-receptor complex can now pass into the nucleus
	Explain why the steroid hormone can pass thr (3) the plasma membran one cannot.	
3.		
3.		

### Task 3 The control of blood glucose

The control of blood glucose levels is an example of homeostasis, and involves also involved, as are the adrenal glands.

1.	Explain why the pancreas is considered to be an organ.	
		•



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### 2. Fill in the gaps in the following flow chart to show how blood glucose leve

	חוא מסטמ ו	cose level rises	
		<u></u>	
This is de	etected by	in the islet	s of
	,	<b>L</b>	
These or	ells produce and	release	in re
		(1) (1)	
This hormone try gis i	je,	and binds to	
	. ***	<b>\</b>	
sinding, the hormo	ne initiates a res	sponse via a	
		•	
This results in gl			
being converted int	to	_ and glucose be	ing the p
		Ţ	
This results in h	alood glucose lev	/els	hack to
	0		
When blood glucose levels fall State one effect that glucagon glucose level.			
State one effect that glucagon			
State one effect that glucagon			
State one effect that glucagon			
State one effect that glucagon			
State one effect that glucagon glucose level.			
State one effect that glucagon glucose level.  Define the following terms:			
Define the following terms:	has on target co	ells, and explain v	what effe
Define the following terms:	has on target co	ells, and explain v	what effe
Define the following terms:  Glycogenesis  Gly lysis	has on target co	ells, and explain v	what effe
Define the following terms:	has on target co	ells, and explain v	what effe
Define the following terms:  Glycogenesis  Gly lysis	has on target co	ells, and explain v	what effe

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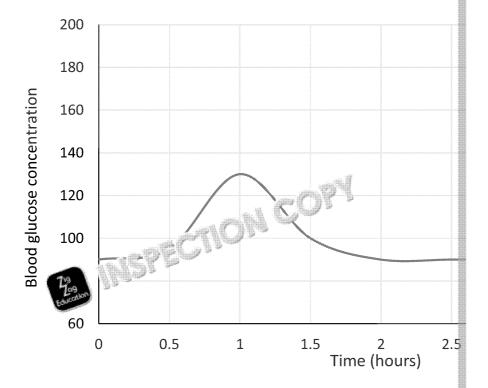


### Describe the reasons that blood glucose levels fluctuate. **Diabetes** Task 4 Describe the difference between a Describe the treatment for each type of diabetes, and explain why it is different type of diabetes.

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3. The following graph shows the fluctuations in blood sugar levels in a person



a)	Suggest what has happened to make the blood glucose levels in	crea

Sketch on the graph the curve you would expect a diabetic person t	ċ
Label your curve.	

c)	In a non-diabetic person, according to the data provided, when wo	
	blood insulin concentration? Explain your answer.	

***************************************	***************************************	 

d)	What important information	is missing from	n the graph?
			1,000

b)

4.	Discuss the possible sources of sull	or treating people with type I di	al
----	--------------------------------------	-----------------------------------	----

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### Quick recap

Say whether the following statements are true or false. For the false ones, wri

- a) Hormones are produced in exocrine glands.
- b) Hormones can be proteins or steroids.
- c) Hormones travel in the blood.
- d) All hormones bind to receptors on cell surface membranes.
- e) Positive feedback results in a reversal of a charge
- f) Childbirth is an example of r stre keuback.
- g) ATP is second in enger.
- h) Ster rmones are lipid based.
- i) Protein hormones can pass through the phospholipid bilayer.

### Extension

- 1. Explain how the second messenger system for insulin is a bit different from
- 2. Describe and explain how a decrease in temperature might lead to detrim enzyme pathways of the body.
- 3. Produce a flow diagram to show how the release of insulin from pancreat

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### 2. Thermoregulation

### Learning objectives

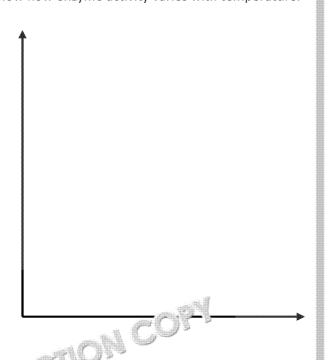
By the end of this lesson, you should be able to:

- Explain the reasons for maintaining temperature
- Define the terms endotherm and ectotherm
- Describe the behavioural responses of ectotherms
- Describe and explain how endotherms maintain their body temperature

### Getting going

1.	Define the following:
	Homeostasis
	Education
	Negative feedback

2. Sketch a graph to show how enzyme activity varies with temperature.



### Keeping water and cooling down

It is in that organisms can use either external sources of heat or in maintain their body temperature. When this is not possible, some organish dormant for some periods of their life; for example, hibernation.

Thermoregulation is an example of a homeostatic mechanism in endother the temperature is at the correct level for enzymes to function.

Body temperature in ectotherms fluctuates with the environment and the try to keep their internal temperature away from the extremes.

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### Task 1 Enzymes and ectotherms

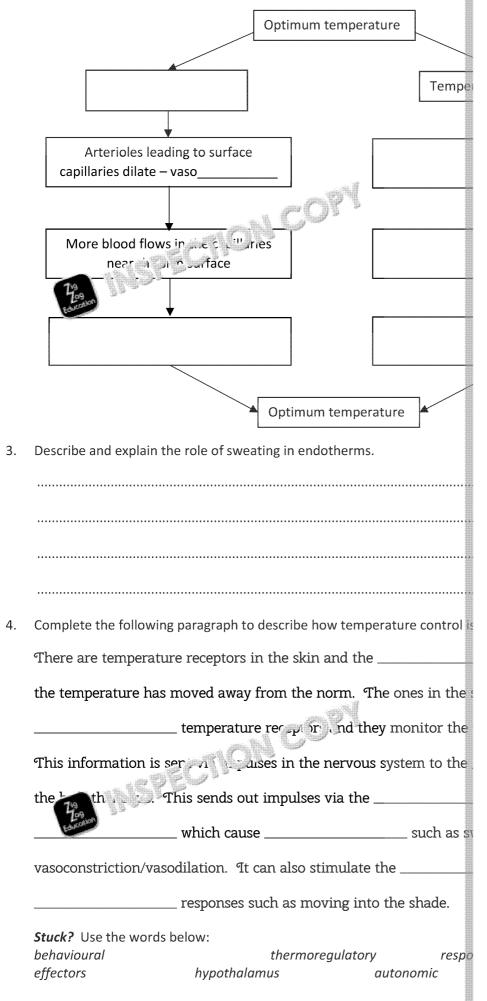
In many organisms, the optimum temperature for enzymes within them is around For these organisms, describe and explain what happens to enzyme activity from 5 °C to 35 °C. Describe and explain the har pens to the enzyme activity when the temp Define the term ectotherm. Match the types of heat transfer to their definitions. Radiation Heat is transferred by 2 Convection В Heat is transferred by di Transfer of heat by infr 3 Conduction For each behavioural a is stat of, explain the benefit: stall change their shape. a) Snakes can often be seen basking in the sun.

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### Some insects move to higher places on the plant that they are curren 6. Some ectotherms have physiological adaptations to be able to cope with One example is the production of cryoprotectants. Suggest what these ch why salt is put on the roads in winter. 7. en suggested that insects might become an important source of protein production in insects (which are ectotherms) might be a more effi Suggest and explain why if you see a bee early in the morning, it might no **Endotherms** Task 2 COPYRIGHT **PROTECTED** Define the term endother

2. Complete the flow chart to explain the control of heat loss from skin capil



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5. Complete the table to compare advantages and disadvantages of ectother

Factor	Endotherm	
Volume of food required		
Proportion of energy used for growth		
Habitat range		
Survival chances without fo		
ity level in low temperatures		
Potential for overheating		

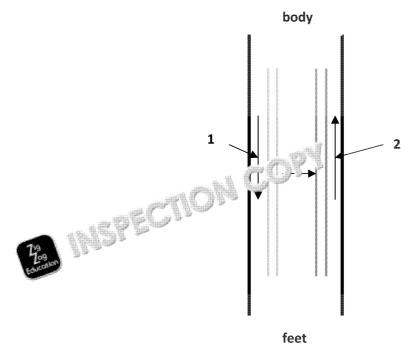
### Task 3 Adaptation examples

1.	Exp a)	lain why each of the following is an adaptation to a cold habitat. In colder environments, the animals are usually larger than their couthe world.
	b)	The animals also usually have thick layers of subcutaneous fat.
	c)	The animals have smaller extremiles of chas smaller ears.
		73

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2. The following diagram shows the arrangement of blood vessels in a bird's numbers 1–3 to explain how a countercurrent system enables some birds



1		
3.		
	cribe how a similar system can keep an organ, such as the brain, cool	
*****		

3.





### Quick recap

### Quick-fire questions:

1.	Name the place in the brain that detects the temperature of the blood.
2.	A creature that relies on external sources of heat is an
3.	Name the type of adaptation that movement into shade is.
4.	What type of heat in the sinvolved in heat leaving the capillaries in the
5.	Name the structures that detect rises and falls in temperature.
6.	The term for when two liquids flow in opposite directions is

### Extension

Produce a scientific poster on thermoregulation. This could be either general in particular organism. Factors to include:

- Title short and draws attention
- Definitions succinct
- Binomial names of organisms used as examples
- Layout make it clear and concise; use bullet points where appropriate
- Use graphics, and reference the source of them



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### 3. Excretion – the kidneys ar

### Learning objectives

By the end of this lesson, you should be able to:

- Describe the origin of excess amino acids
- Describe the structure of a nephron
- Describe the processes of ultrafiltration and selective reabsorption
- Explain how the countercurrent mechanism in the loop of Henle leads to
- Describe and explain the process of osmoregulation

### Getting going

### The kidners

Most p have two kidneys which are adapted to remove substances from levels. The kidneys have a blood supply — the renal artery bringing blood to taking blood away from the kidney and back to the heart. The renal artery which in turn split up into glomeruli where the blood undergoes ultrafiltra substances leave the blood and enter the nephron. Unusually for an organ glomerulus then join back up again to make the efferent arteriole. This will with oxygenated blood. The fluid in the nephron will eventually become the evolved to make sure that any useful substances are reabsorbed from the gurine is excreted.

1. Define the terms in the table below.

Excretion	
Secretion	
Nephron	
Liver	
Amino acid	
Epithelial cell	
Microvilli	

2. Describe how you would to the presence of protein and reducing sug include what the notice of a unit would be.

rc Zza	
educing sugar:	

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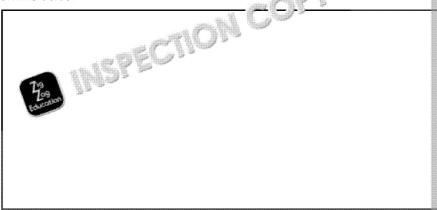


### Task 1 Amino acids and nephrons

### Urea

One of the main excretory products that the kidney removes from the bloomade in the liver from excess amino acids from proteins in our diet. The kiny tubes called nephrons. Each part of the nephron has a particular role

 Draw the general chemical formula of an amino acid, and label the groups amino acids.



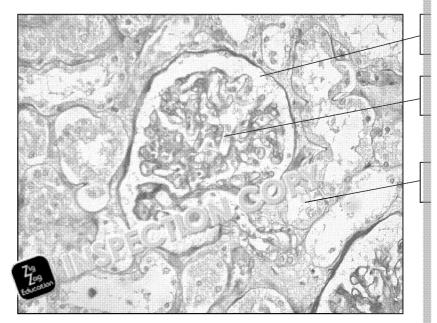
- Explain how amino acids end up in the blood after we have eaten a meal of the second se
- 4. Label the following diagram of a nephron to include Bowman's capsule, Proof the loop of Henle, DCT, and collecting duct. Add the blood supply to the Extension Annotate the name of the processes occurring where appropri



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### 5. Identify the labelled structures on the diagram using the terms *glomerulu* convoluted tubule on the following slide.



6.	Synoptic – A student measured the maximum diameter of the Bowman's The actual width was 200 $\mu m$ . Calculate the magnification of the image.
7.	On some slides like this it is possible to identify the difference between publics – suggest how this might be possible.
8.	Explain why some tubes look circular, and some look more oblong. Thinl been created.
	SOF S

### Task 🚁 🗥 Miliration

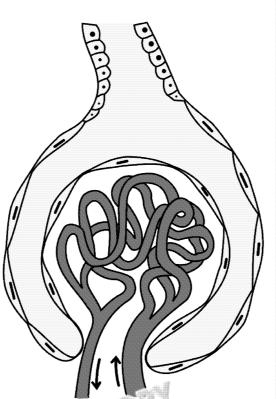
### The Bowman's capsule

Ultrafiltration is the process by which substances leave the blood inside the enter the Bowman's/renal capsule — the first structure of the nephron. It is substances that we need, such as glucose and amino acids, are filtered out to get rid of, such as urea and some ions. This is why, after ultrafiltration, be reabsorbed back into the blood — see task 3.

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### 



4.	Describe and explair + Fiff2 ence in structure between the afferent and
	Edicolor

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5.	State the layers that substances have to pass through during ultrafiltration
	the layers have.
6.	In a healthy person of blood is processed every minute, which e
	volution of unit is 1300 cm <sup>3</sup> being produced over one day. During this pr
	ent Bowman's capsule every minute.
	What would be the volume of filtrate produced by the kidneys in a day?
	That would be the folding of merate produced by the maneys ma day?
_	
7.	Suggest why some people might argue that the glomerular capillaries are

### Task 3 Reabsorption

### Path of the filtrate

After the substances have been filtered out of the blood and are in the cap as the filtrate. This filtrate now enters the proximal convoluted tubule, and Henle, the distal convoluted tubule and then the  $c_{i}$  is ing duct. Any fluid will eventually become urine and, therefore let re the body. Selective reads convoluted tubule and the action  $c_{i}$  op of Henle ensure that any sub keep are reabsorbed back in oit.  $e_{i}$  bodd.

In the PCC al' ' he plucose and amino acids are reabsorbed, along with (stranger) me area.

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Rodium ions a	ro	trans	norted out of the	
Dourant 10115 a		ti ti ti	ported out or the	
	n	nembrane. This lowe	ers the	
inside the cell	. Sodium io	ns	into the ce	
form of facilit	ated diffusio	on. This is called		
+la-+ :- lauii		:	···	
mat is bringir	ig soutuitt to	ns into the cell also	Tuß2	
	in at	the same The	se molecules can	t
		(9)		
	(	enter the blood. The	nis lowers the	
tiss did ar	id the blood,	so water is also reab	sorbed by	
here		is so small that	it can diffuse int	
Itere.		15 50 Siliali tilat	it can unituse inte	
Stuck? Use the				
•		ncentration glo basal		<b>'</b>
uctively	uiiiuse		acmacic d	<b>*</b>
	,,,	Dusui	osmosis c	
	,,,	busui	osmosis c	
The following ta		e approximate concentra		
The following ta	ible shows the			
filtrate and urin	ible shows the	e approximate concentra	ations of substances	
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filtrate and urin	able shows the e. nce	e approximate concentra Concentration in plasma	ations of substances  Concentratio filtrate	
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Substan  Wate Glucos Amino a  Protei Sodium	nble shows the e.  nce r se cids ns	Concentration in plasma  92  0.1  0.04  8  0.4	Concentration filtrate 92 0.1 0.04 0 0.4	
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Substar  Wate Glucos Amino a Protei Sodium Urea	nble shows the e.  nce r se cids ns ions	Concentration in plasma  92  0.1  0.04  8  0.4  0.02	Concentration filtrate 92 0.1 0.04 0 0.4 0.02	
Substar  Wate Glucos Amino a Protei Sodium Urea	nble shows the e.  nce r se cids ns ions	Concentration in plasma  92  0.1  0.04  8  0.4	Concentration filtrate 92 0.1 0.04 0 0.4 0.02	
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Substar  Wate Glucos Amino a Protei Sodium Urea	nble shows the e.  nce r se cids ns ions	Concentration in plasma  92  0.1  0.04  8  0.4  0.02	Concentration filtrate 92 0.1 0.04 0 0.4 0.02	
Substar  Wate Glucos Amino a Protei Sodium Urea	nble shows the e.  nce r se cids ns ions	Concentration in plasma  92  0.1  0.04  8  0.4  0.02	Concentration filtrate 92 0.1 0.04 0 0.4 0.02	COPYRIC
Substan  Wate Glucos Amino a Protei Sodium Urea  a) State one in	r se cids ions improvement t	Concentration in plasma  92  0.1  0.04  8  0.4  0.02  that could be made to t	Concentrations of substances  Concentration filtrate  92  0.1  0.04  0  0.4  0.02  The layout of the tab	COPYRIC
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Substan  Wate Glucos Amino a Protei Sodium Urea  a) State one in	r se cids ions improvement t	Concentration in plasma  92  0.1  0.04  8  0.4  0.02  that could be made to t	Concentrations of substances  Concentration filtrate  92  0.1  0.04  0  0.4  0.02  The layout of the tab	COPYRIC

d) Explain why the concentration of urea incr	eases when comparing the	
The loop of Henle		
The loop of Henle is a part of the nephron that i the surrounding tissue fluid have a high concent means water will move into this tissue fluid, and	ration of ions, and, theref	
3. Complete the table by matching the process vi	t) the number on the diag	
C.	Number on diagram	
airpin into the tissue fluid.		
Sodium and chloride ions are actively transported out of the thick part of the ascending limb.		
Water moves out of the descending limb by osmosis.		
Sodium and chloride ions diffuse into the descending limb.		
4. What is the name for this system where the tw	o fluids are flowing in once	
4. What is the hame for this system where the tw	o naids are nowing in oppo	
5. Suggest why desert animals have relatively long	loops of Henle.	
	~3 <sup>3</sup> \	COPYRIGHT
Task 4 Osmoreguicto		PROTECTED
Region Lacer content		
Osmore ation is the process by which animals Most of the water is reabsorbed in the PCT, but reabsorbed in total, and this happens in the colle	there needs to be a way o	Zig
Define negative feedback.		Education

### 2. Order the statements to show what happens when the water potential of

A signal is sent to the posterior pituitary to release more A
Water potential of the blood returns to normal
A cascade of reactions occurs resulting in vesicles containing fuse with the cell membrane
More water is reabsorbed by osmosis; smaller volume of u
ADH binds to receptors on the cells lining the collecting du
This increases the permeability of the collecting duct to wa
cAMP is formed in the cell
Osmoreceptors in the language of the control of the

3.	Alcoholing has bease of ADH. Suggest and explain the effects that or

### Quick recap

State whether each statement is true or false. If you think it is false, correct th correct version.

- a) Amino acids are the monomers of a protein.
- b) All amino acids contain sulfur.
- c) The afferent arteriole brings blood to the glomerulus.
- d) The capillaries in the glomerulus are lined with podocytes.
- e) The basement membrane determines which molecules can be filtered out
- f) Selective reabsorption results in all of the glucose haifig taken back into the
- g) The cells of the PCT are lined with vi'' or case the surface area.
- h) The loop of Henle can a cuntercurrent mechanism.
- i) The tis loop of Henle, the higher the water potential can be in the
- j) ADH is released from the hypothalamus.
- k) ADH release causes more water to be reabsorbed from the collecting duct

### Extension

Research the causes of and treatments for kidney failure. Present your research

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### 4. The nervous system and contr

### Learning objectives

By the end of this lesson, you should be able to:

- State the events in a reflex arc
- Describe the structure of a motor neurone and state how it is specialised
- Compare and contrast the functions of the nervous system with the endo
- Describe the events in the resting potential and action potential, and expl
- Describe and explain how an impulse is transmitted along a neurone, and in myelinated vs unmyelinated neurones
- Describe the events of synaptic transmiss on
- Describe how the heart beat in this way
- Describe and explaining the heart rate is increased or decreased.

### Getti. 😘 əmg

**ATP** 

1.	Write a flow chart to show the seri	es of structures in a reflex arc, starting
2.	Complete the table by defining the	terms.
	Channel protein	

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Ion

Active transport

Diffusion

Faund cirfusion

Frequency

Exocytosis

### Specialised cells

The cells that make up the nervous system are called neurones. They are sfunction, which is to transmit information from one part of the body to an have Schwann cells wrapped tightly around them in order to give the cells Their membranes contain the channel and carrier proteins that are needed membrane of the neurone.

### Task 1 Neurones

 Draw and label a motor neurone in the book io / Aud annotations to sh its function.



	1.	
	2.	
	dim s	
	3.	
3.	Wh	at is the function of the receptors in the reflex arc?
4.		te three stimuli that the 's to respond to, and suggest how it
	1.	
	2.	
	3.	

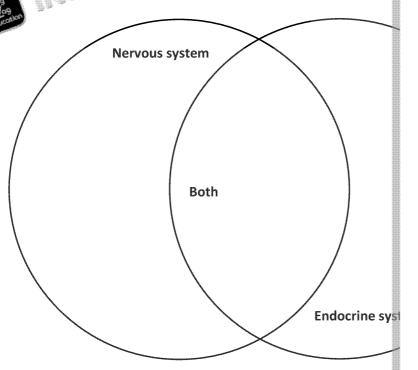
Describe three ways in which a sensory neurone is different from a motor

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### 5. What is a nerve?6. Describe the difference between the somatic (motor) nervous system and

7. Complete the Venn diagram and the reason for the systems, the method of travel and the during the ffect.



8. Match up the parts of the brain to the functions that they carry out.

1	Cerebellum	
2	Cerebrum	
4	Hypothalamus	

£	contains the cardiov respiratory centre
В	Balance and posture
С	Thermoregulation, chunger, aggression
D	Conscious thought,

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### Task 2 The resting potential

### A difference in charge

The neurone membranes are said to be polarised. There is a potential difference when the neurone is at rest (when there is no information being sent), the more negative than the area surrounding the cell. When a message needs this potential difference is reversed – the inside becomes positive when cothe cell.

1.	Name the ions that are involved in the resting political and action poter
2.	State the point is a fference across the membrane when it is at rest. Er
3.	Fill in the gaps to describe how the resting potential is created and maint if you get stuck.
	The membrane of the neurone contains sodium/potassium pum
	channels. The sodium potassium pump uses
	three ions out of the cell for every two
	transports into the cell. This creates
	sodium ion channels are, so sodium cannot
	point. Some of the potassium channels are, s
	diffuse by back out of the cell. This mean
	ions outside of the cell, and less of them inside
	Stuck? Use the words below:
	ATP facilitated diffusion concentration gradie
	potassium positive potential d'if et se oper
4.	Explain why the cytoplasm of the locality contains many mitochondria

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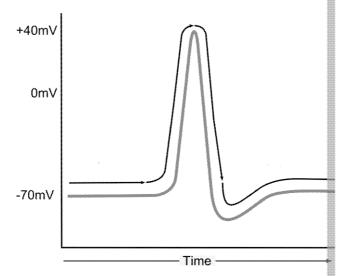
### Action potentials

When a message needs to be transmitted down a neurone, the neurone do of the resting potential — an action potential occurs. This is a change in the caused by the movement of ions again. The potential difference increases +30 mV, and then back to -70 mV after a brief overshoot to -80 mV. These potential, and it either happens or it doesn't — all action potentials are the the all or nothing response.

These differences in charge were worked out by using electrodes – these d charge when stimuli are applied to a neurone and are displayed on an osci to see how neurones respond to different stimula.

### Task 3 The confined

1. Lab raph of the action potential with the following stages – repolar hyperarisation, resting potential.



2. Number the statements to show the correct sequence of events for an account of the statements to show the correct sequence of events for an account of the statements to show the correct sequence of events for an account of the statements to show the correct sequence of events for an account of the statements to show the correct sequence of events for an account of the statements to show the correct sequence of events for an account of the statements of the statements of the statement of the

The inside of the axon becomes hyperpolarised, leading to the refra		
Some sodium ions diffuse into the cell.		
The membrane is at resting potential.		
Sodium ions diffuse into the acit		
The membrane i) and or unstoresting potential.		
ာsi ် င ကe cell starts to become more positive compared with		
ugh sodium ions enter, the threshold will be exceeded and the		
Some sodium ion channels open.		
This is repolarisation.		
This causes more sodium ion channels to open (voltage gated).		
When the charge reaches about +35 mV, the voltage-gated sodium is voltage-gated potassium ion channels will open.		
Potassium will diffuse out of the cell; the inside will become less pos		

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3.	Explain how depolarisation is an example of positive feedback.
4.	Explain what is meant by a voltage-gated ion channel.
5.	Describe and Vision the all or nothing principle. You may want to sketch

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### Task 4 Transmission of the impulse

### Action potentials

One action potential of a lat one small point in the membrane at one part for the lag of get from one end of the neurone to the other, action potential the neurone in a coordinated way – the impulse needs to be one action potential causes another action potential in the neighbouring produce by the action potential creating a local current which then initiates the myelinated neurone the action potential can only happen at nodes of Rank

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Zig Zag Education

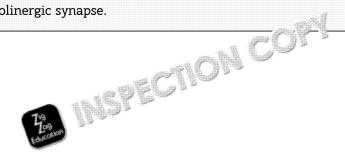
		. V#		
		<u> </u>		
		*		
What is the kind of	ion called in a r	nyelinated neurone	?	
	<b>*</b> → ***			
Explain why transm	ission is faster in a myelii	nated neurone.		
		***************************************	***************************************	
		***************************************	**********	
The speed of transn	nission was measured for	neurones from sev	eral differ	
The speed of transn	nission was measured for	neurones from sev	eral differ	
shown below.	nission was measured for			
		neurones from sev	eral differ  Tem	
Organism Giant squid	Diameter of axon (µm)	<b>Myelinated</b> No		
Organism Giant squid Frog	Diameter of axon (µm) 1000 15	<b>Myelinated</b> No Yes		
Organism Giant squid Frog Cat	Diameter of axon (μm) 1000 15 20	Myelinated  No  Yes  Yes		
Organism  Giant squid  Frog  Cat  Worm	Diameter of axon (μm) 1000 15 20 55	Myelinated  No  Yes  Yes  No		
Organism  Giant squid  Frog  Cat  Worm	Diameter of axon (μm) 1000 15 20	Myelinated  No  Yes  Yes  No		
Organism  Giant squid  Frog  Cat  Worm	Diameter of axon (μm) 1000 15 20 55	Myelinated  No  Yes  Yes  No		
Organism  Giant squid  Frog  Cat  Worm  What is wrong	Diameter of axon (μm) 1000 15 20 55	Myelinated  No Yes Yes No No	Tem	
Organism Giant squid Frog Cat Worm  What is wrong	Diameter of axon (µm)  1000  15  20  55  with the format of the ta	Myelinated  No Yes Yes No No	Tem	
Organism  Giant squid  Frog  Cat  Worm  What is wrong	Diameter of axon (µm)  1000  15  20  55  with the format of the ta	Myelinated  No Yes Yes No No	Tem	COPYRIGHT
Organism Giant squid Frog Cat Worm  What is wrong	Diameter of axon (µm)  1000  15  20  55  with the format of the ta	Myelinated  No Yes Yes No No	Tem	
Organism  Giant squid  Frog  Cat  Worm  What is wrong	Diameter of axon (µm)  1000  15  20  55  with the format of the ta	Myelinated  No Yes Yes No No	Tem	
Organism  Giant squid  Frog  Cat  Worm  What is wrong	Diameter of axon (µm)  1000  15  20  55  with the format of the ta	Myelinated  No Yes Yes No No	Tem	
Organism Giant squid Frog Cat Worm  a) What is wrong b) Describe how t	Diameter of axon (µm)  1000  15  20  55  with the format of the ta	Myelinated  No Yes Yes No able?	Tem	
Organism Giant squid Frog Cat Worm  a) What is wrong b) Describe how t	Diameter of axon (µm)  1000  15  20  55  with the format of the ta	Myelinated  No Yes Yes No able?	Tem	

	d)	Suggest an explanation as to why increasing temperature can increas
5.		ension – Changes in external temperature affect the speed in conduction lotherms. Suggest why this is.
		-051
ŝ.	Exp	y 1 3 snort period of hyperpolarisation is important.
	*****	
	****	

### Task 5 Synapses

### Crossing the gap

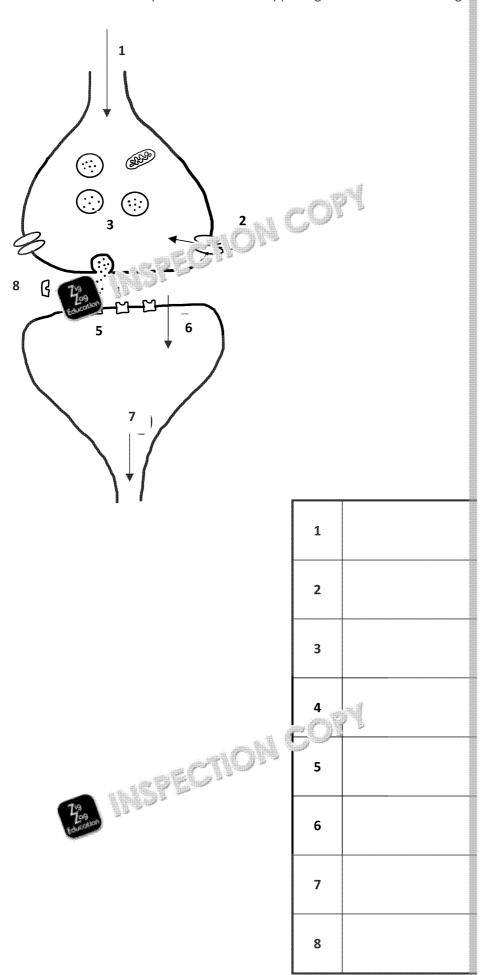
Once the impulse reaches the end of the neurone, the information needs to neurone. This is done by a synapse. This is where a chemical called a neurone presynaptic neurone, and binds to a cell surface receptor on the post smany different neurotransmitters, especially in the brain. If acetylcholine cholinergic synapse.



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1. Add suitable descriptions for what is happening at each numbered stage c



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### 2. Explain why the presynaptic neurone has many mitochondria. 3. Suggest why the presynaptic membrane has lots of smooth ER. 4. Explain box (s. pse Is able to ensure one-way transmission.

The way the synapse works allows for messages to be sent between many different interesting roles of the synapse; it isn't just about one impulse getting from on postsynaptic neurone. Synapses allow a plethora of communication between

5. Match the descriptions of the roles of the synapse to the roles of the syna

1	Convergence
2	Divergence
3	Spatial
3	summation
4	Temporal
†	summation
5	Habituation
6	Unidirectional
7	Generator
	er
8	
9	IPSP

Д	Action potentials arriving
	neurones at the same tim
В	Potential becomes more
С	The nervous system no lo
ם	One presynaptic neurone
	postsynaptic neurones
_	Potenial becomes more
	r csynaptic cell
	Several presynaptic neuro
	postsynaptic neurone
G	Travelling only one way
Н	The change in potential in
	Several action potentials
1	neurone within a short pe

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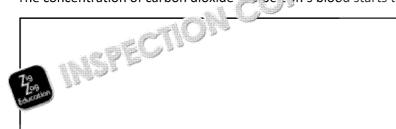


### Task 6 Nervous control of heart rate

### Changing the rate

The heart obviously needs to beat all of the time in order to get oxygen an respiration. But as we all know, the heart can increase the rate at which it again according to the needs of the body. For example, if you go for a run, supply blood at a faster rate to the cells which are carrying out a higher raheart rate will need to be decreased again upon completion of the exercise endocrine and nervous systems.

- 1. Say whether each of the following structure or false. For the false rewrite them in order to have them correct.
  - a) is a post of tissue in the left atrium called the sinoatrial node
  - b) me brain sends an impulse to the SAN to initiate the impulse.
  - c) The impulse results in a wave of excitation over the walls of the atria
  - d) The contraction forces blood from the aorta into the ventricles.
  - e) The transverse septum across the heart is an electrical insulator.
  - f) Only the SAN can transmit the electrical impulse.
  - g) This means that the impulse is delayed slightly, allowing the atria to
  - h) The impulse then spreads down to the Purkyne fibres where the impulse ventricles at the base.
  - i) This causes the walls of the ventricles to contract from the top down
  - j) Blood is forced upwards towards the aorta and atria.
- 2. Construct a flow chart to describe and explain what would happen in each Ensure you talk about receptors, impulses, sympathetic and parasympath
  - a) The concentration of carbon dioxide is a be son's blood starts to increase.



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### b) A person's blood pressure increases. 8. Extension – Resa Can ware ANS causes the release of adrenaline and ware and

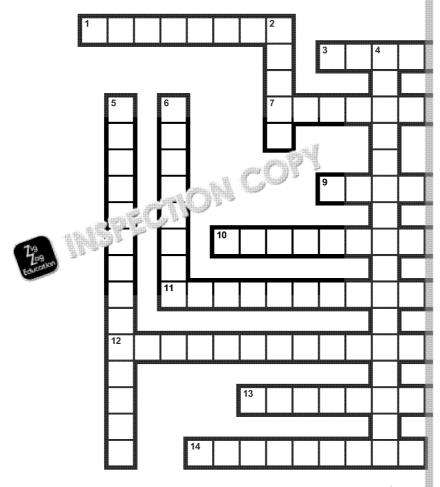
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### Quick recap

Complete the crossword below.



Across

- 1 Cardiac muscle is said to be this (8)
- 3 Part of a neurone that allows communication with other cells (8)
- 7 The number of times something happens within a particular time frame (9)
- 9 A type of neurone that takes messages away from the CNS (5)
- 10 When the nervous system no longer responds to a stimulus it is said to be this (10)
- 11 This happens when potassium ions flood cur on the call (14)
- 12 A neurotransmitter found at change c synapses (13)
- 13 The combined effect evalur EPSPs (9)
- 14 The of the coon that happens along myelinated ne (9)

### Extension

Research the effect of drugs on synaptic transmission. For each one try to find synapse, and what the effects on the body therefore might be. Examples inclu Valium, botulin, insecticides.

zzed.uk/12188-mouse



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### 5. Plant hormone

### Learning objectives

By the end of this lesson, you should be able to:

- Define the term tropism
- Describe how plant hormones are able to initiate a response to stimuli
- Use an example to show the complex action of plant hormones apical de
- Explain phototropism and geotropism

### Getting going

In the box below, draw and label a ge and cell.



### Responding to stimuli

Plant hormones control the responses that plants make to external stimuli they should be termed plant growth regulators/substances as there are diff and how hormones function in mammals, but there are also similarities.

There are many different plant hormones that a concluded in various partin many responses to stimuli. This includes the growth of side shoots, growth and seed germination.

### Task 💹

### The nature of plant hormones

1.	Nar	ne three stimuli that a plant needs to respond to, and for each one st
	1.	
	2.	
	3.	





### Describe what is meant by a meristem area of a plant. Discuss reasons for and against terming these chemicals that control plan Auxins are involved in apical dominance. Auxin is produced in the tip of the plants are involved in apical dominance. inhibits the growth of side shoots. Explain why removing the tip of the growing shoot will cause side shoots 5. Read the following passage about the role of auxins and then answer the Auxins are produced in the tip of the plant by cells that are able down the plant; some evidence shows that some ATP is required initiate a response in cells further down the like ht, the auxin need COPYRIGHT surface of the cells. This causes had one ions to be pumped out **PROTECTED** The presence of hydroger is is sailes the cells to remain flexible The cell cannot keep a mature of ر باو of tissue that the cells in the tip belong to. What kind of transport might be involved in moving auxin down the What type of molecule will the auxin be binding to?

### d) Where will the hydrogen ions end up? e) Suggest why the presence of hydrogen ions allows the cells to remain f) Suggest what happens to cause the cells to expand. Task Tropisms 1. Define the term tropism.

2. Complete the table to show some of the different types of tropism.

Tropism	Description
Positive phototropism	
Positive geotropism	
Negative chemotropism	
Positive thigmotropism	

When a plant is exposed to light from all directions, it grows vertically upwards one direction, it will bend towards the light. Auxins control this response, and root downwards.

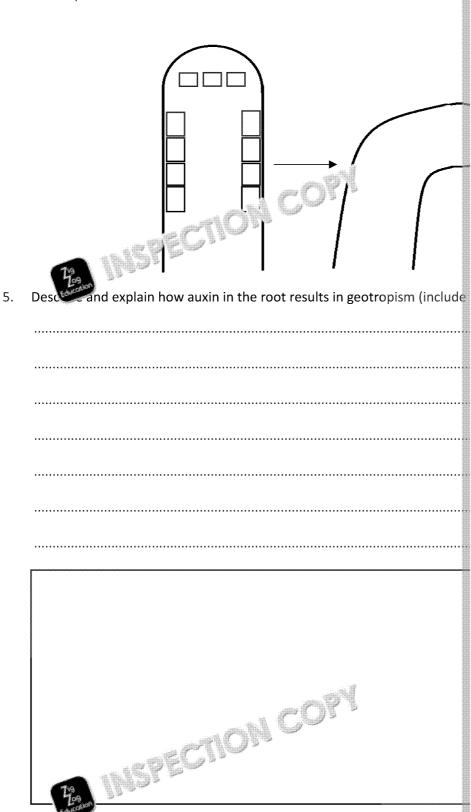
3. Order the statements to show how auxin con to sais

	This means there is to be concentration of auxin on the shilluminate is de
	r ) oves down the plant; it is distributed evenly
Library	This causes the shaded side to grow longer than the unshade towards the light
	Therefore, the cells on the shaded side are stimulated to elor illuminated side
	Auxin is produced in the growing tip of the plant
	When light is shone from only one side, the auxin moves awa shaded side

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### 4. Complete the diagram to show what happens to the size of the cells on both this response.



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### 6. Various scientists, including Darwin, have carried out experiments to show Complete the table to explain what can be concluded from each of the res from only one direction.

Diagram	Treatment	Result
	Tip removed	
	Tigge of out  A Ga with a cap  that is opaque	
	Tip removed, then replaced but with a gelatine block in between	
	A thin glass plate is inserted to separate two sides of a shoot	

7.	Suggest and explain what would happen in the last experiment if the glather top of the tip.
	- co <sup>y</sup>

### Task 🔼 Wactical investigations

A student carried out an investigation into the action of auxin on shoot growth changing the concentration of auxin had an effect on the level of phototropism create a range of auxin concentrations, starting with a stock solution of 10 gdm days without any treatment, and then chose five seedlings for each concentrat the tip from each shoot, and applied the auxin to the seedlings. After three days are the seedlings of the seedlings of the seedlings of the seedlings.

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### Describe how the student would have made their range of five auxin conc which was 10 gdm<sup>-3</sup>. Suggest an appropriate control for this experiment Explain why the student removed the tip from the seedlings. What was the purpose of having five seedlings for each concentration? State two factors that are not mentioned which should have been control needs to be controlled.

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6. Another student carried out an investigation into the effect of auxin concert hey used a different range of concentrations and repeated each concent shown below.

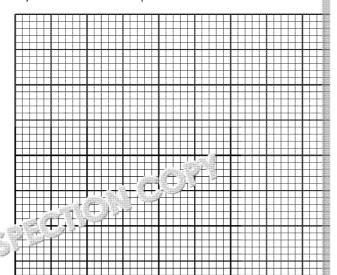
Concentration of auxin	Percentage stimulation						
(ppm)	1	2	3	4	5	Mean	
$1 \times 10^{-5}$	0	2	0	0	1		
1 × 10 <sup>-4</sup>	12	15	16	17	15		
$1 \times 10^{-3}$	42	57	66	44	40		
$1 \times 10^{-2}$	25	26	28	15	22		
$1 \times 10^{-1}$	2	0	1	) )	0		

- a) Calculate the mean and so, each concentration and enter this info
- b) Calculate the induced deviation for the data sets at  $1 \times 10^{-4}$  and  $1 \times 10^{$

$$s = \sqrt{\frac{\sum (x - \overline{x})^2}{n - 1}}$$


 	 *****

7. On the following graph paper, plot the mean values for all of the concentre deviation information you worked out in question 6.







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8.	What do the standard deviations you have worked out (concentrations 1	
Q	ıick recap	П
	te whether the following statements are true (false) for the ones that are correct version.	
a)	A tropism is a direction of the response.	
b)	Auxin is produced in all areas of a plant.	
c)	Auxin stimulates elongation of cells in the root.	
d)	When a plant grows towards a light source it is positively geotropic.	
e)	Standard deviation is a measure of variance about the mean.	
f)	Auxin stimulates growth of side shoots.	
g)	All plant cells can divide.	
E	xtension 3091	COPYRIGHT
1.	Research what a PIN proteins.	PROTECTED
		<b>7</b> io
		79
		Education

2. Compete the table to show the effects of some other plant hormones.

Hormone	Functions	****
Gibberellins		
Cytokinin		
Ethene	- 1 CO? 1	
Abscisic acid		

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### 6. Muscle contracti

### Learning objectives

By the end of this lesson, you should be able to:

- Describe the structure of skeletal muscle
- Identify structures of a muscle fibre on diagrams and micrographs
- Describe the events that occur at a neuromuscular junction
- Describe and explain the sliding filament theory of muscle contraction
- Explain the importance of calcium ions
- Describe and explain the role and supply of ATP

### Getting going

1. Complete the telescelled in to describe protein structure.

Le 1 protein	Description / labelled diagram
Primary	
Secondary	
Tertiary	

2.	Some proteins show quaternary structure – explain what this is with refe

### M

### s and movement

We are all aware that muscles allow us to move. What we mostly think are skeletal muscles. There are other types of muscles as well, doing diff thing in common – they contract to bring about movement.

Skeletal muscles are very regimented in their structure, which gives the This is due to the particular arrangement of proteins – actin and myosir make the muscle shorter, hence contracted. This requires ATP, so musc at all times and this can come from different sources.

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### Task 1 Muscle structure

1. Match the type of muscle to its function.

Cardiac muscle

Skeletal muscle

Smooth muscle

Attached to bones, under

Contractions cause blood from ventricles to arteries

Under involuntary control

2. Define the following:

<b>V.</b>

pl.sn.

c) Sarcoplasmic reticulum......

.....

Muscle cells form multinucleate fibres. These fibres contain myofibrils, w myosin are found in their very regular arrangement. They are arranged so one section is a sarcomere.

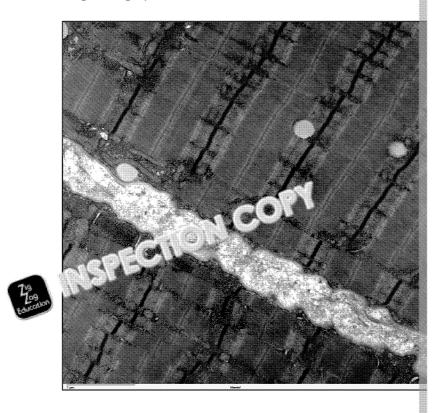
- 3. Name the filaments which:
  - a) are made of actin and tropomyosin ......
  - b) are made of myosin .....
- On the following diagram, label a myosin filament, an actin filament, an I l and one sarcomere.



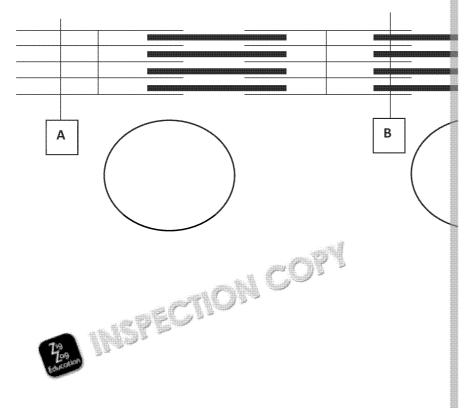
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5. On the following micrograph, label a sarcomere.



6. In the circles below, draw what would be seen if a section was cut at point end-on

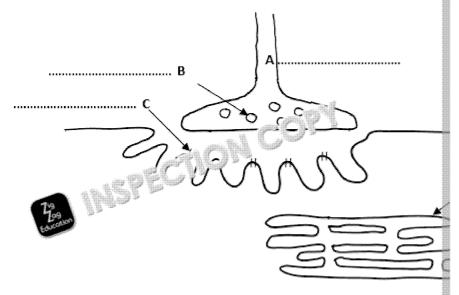


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### Task 2 The neuromuscular junction

In order for a muscle to contract, it needs to be told to do so. This involves an neurone, and then causes the message to be transmitted to the muscle. The n through the neuromuscular junction, shown below.



- 1. Label A–D on the diagram.
- 2. For each of the steps in the flow chart below, circle or highlight which is t
  - A An action potential arrives down a sensory neurone
  - B An action potential arrives down a motor neurone
  - A Calcium ion channels open and calcium ions diffuse into the postsyn
  - B Calcium ion channels open and calcium ions diffuse into the presyna
  - C Calcium ion channels open and calcium ions diffuse out of the presy
  - A This causes vesicles to move and fuse with the presynaptic membra
  - B This causes vesicles to release acetylcholine into the cytoplasm
  - C This causes acetylcholine to move and fuse with the presynaptic me

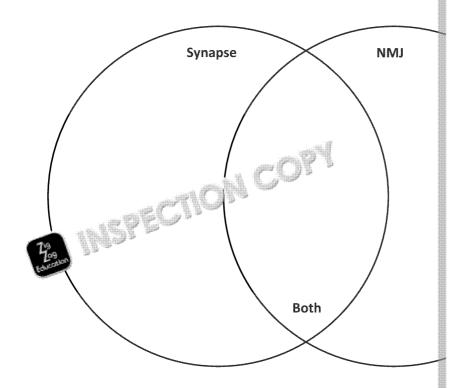
Acetylcholine diffuses across the cleft and bind with receptors on the s

- A This causes calcium ion in nies o open and calcium ions diffuse in
- B This cause: Land channels to open and sodium ions diffuse in
- A nflux of ions depolarises the sarcolemma
- B The influx of ions causes an action potential
- C The influx of ions hyperpolarises the membrane
- A This causes calcium ions to be actively transported out of the sarcor
- B This causes calcium ions to diffuse out of the sarcoplasmic reticulum
- C This causes sodium ions to be released from the sarcoplasmic reticular

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3. Complete the Venn diagram to compare and contrast a synapse with the Think about types of neurotransmitters, how the signal moves, what structure the process, and what the result is.



4. Describe what a t-tubule is and explain its function.									

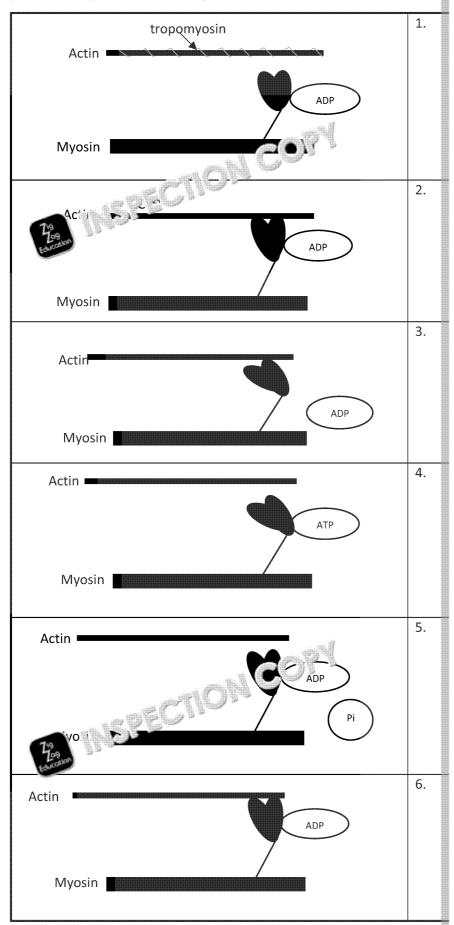


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### Task 3 The sliding filament theory

For each of the diagrams below, add a description to describe what is hap
pictures, and your own knowledge.



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### Describe the role of calcium ions in muscle contraction. State what happens to the last contraction of the last The myosin molecules are joined to each other at the bases of the molecules would happen during muscle contraction if they were not bound to each Describe and explain what would cause muscle contraction to stop. Explain the role of creatine phosphate (phosphocreatine) in the supply of

# NSPECTION COPY



### Explain why marathon runners need higher numbers of mitochondria that Extension – Suggest what happens to cause rigor mortis. This happens jus muscles contracting. Quick recap Fill in the gaps to complete a summary of muscle contraction. There are three main types of muscle – skeletal, cardiac and \_\_\_\_\_ skeletal muscle are \_\_\_\_\_\_ in appearance due to the proteins that make up the \_\_\_\_\_\_. There are several muscle fibre and they are surrounded by the \_\_\_\_\_ membrane of muscle cells. When an impulse arrives at a neuromusc \_\_\_\_\_ to be released which binds to \_\_\_\_\_ This causes \_\_\_\_\_\_ ions to enter the muscle, and the \_\_\_\_\_. The sarcolemma is folded into \_\_\_\_ the spread of the depolarisation. The depolarisation causes \_\_\_\_\_ released from the \_\_\_\_\_ and I ese ions initiate mus Lach other, and this results in the myosin \_ contraction. This is reliant on a supply of n aerobic respiration, anaerobic respiration and \_\_\_\_\_ **Stuck?** Use the terms given below: creatine phosphate / phosphocreatine receptors striated calcium sodium shorter myofibril smooth acetylcholine Extension Produce a poster explaining the effect of various toxins and venoms on muscle

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### 7. Photosynthesis

### Learning objectives

By the end of this lesson, you should be able to:

- State the role of a pigment
- Describe how to separate different pigments from a mixture
- Relate the absorption of light to the rate of photosynthesis
- Describe the structure of a chloroplast and state which process happens
- Describe and explain the steps in the light-dependent reaction
- Explain the link between the two stages
- Describe the steps in the Calvin cycle. Inc. extend the significance of this control of the significance of this control of the significance of the steps in the Calvin cycle.
- Describe and explain how to so so the rate of photosynthesis
- Explain the effects ( ) actors on the rate of photosynthesis

### Getti. Gorng

***************************************	
***************************************	
	Write the word equation for photosynthesis.
	Write a balanced chemical equation for photosynthes's.

Photo sis is a complex set of reactions that happen in the chloroplast two sections: the light-dependent and the light-independent stages. During is absorbed by photosynthetic pigments, and the light energy is turned into of ATP.

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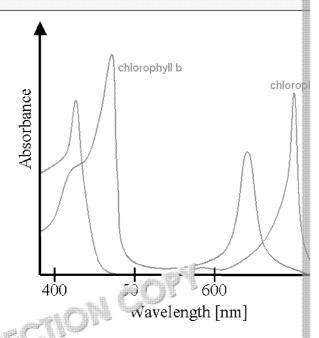
### Task 1 Absorbing light

1.	A bit of physics to start – why do most plants appear green to us?
2.	Name the primary photosynthetic pigment.
3.	Name another photosynthetic pigment.



These pigments are arranged into photosystems, with the primary pigment where photoionisation occurs. This is where light is absorbed by the chlore electrons leave the chlorophyll molecule. The energy from the light is now The membranes of the chloroplast are adapted to harness this energy and

Below is a graph showing the absorption spectrum of photosynthetic pigm



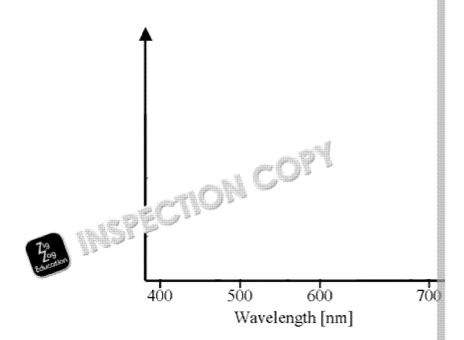
4. Suggest and ( '1 'c. 'vhac colour light is between 525 nm and 575 nm.

1	性				

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5. Sketch a graph to show what the rate of photosynthesis would be for the previous graph.



6.	Some species of seaweed that live in deep water are a red or brown color have evolved in this way – what advantage might this give?

### Task 2 Chromatography

### Chromatography

The variety piges at a unid in chloroplasts can be separated by chromatog crushed polyent (the extraction solvent), dotted onto the origin line on plate, an endipped into a running solvent. The pigments will move up to become separated. This could be used to compare the pigments from two specific than the  $\Re_f$  value is then calculated:

 $\Re_f$  = Distance travelled by substance  $\div$  Distance travelled by solvent front

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1.	Complete the	following tab	le to give	reasons for	each of the	steps in the
-d- *	complete the	TOTIO WITTE COL	he to Bive	1 CG30113 101	cach of the	Jupa III uii

Action	
Bung/lid on the chromatography tube	
Origin line drawn in pencil	
Solvent line recorded when it is near the top of the paper / TLC plate	
Wear gloves	
The paper should be "'s sed conservingin line is above t' ( see 5 me solvent	
The respondence to the sides of the sides of	

2.	Explain why the pigments become separated in this technique.

3. The distance travelled by the solvent front was 96 mm. Complete the following

Pigment	Distance from origin (mm)
Carotene	88
Chlorophyll a	
Xanthophyll	48

4.	Why doesn't the R <sub>f</sub> value have units?

5. When the R<sub>f</sub> value of a substance that is completely insoluble in

6.	Why might you get different R <sub>f</sub> values when using a different solvent?

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### Task 3 The light-dependent stage

### **Phosphorylation**

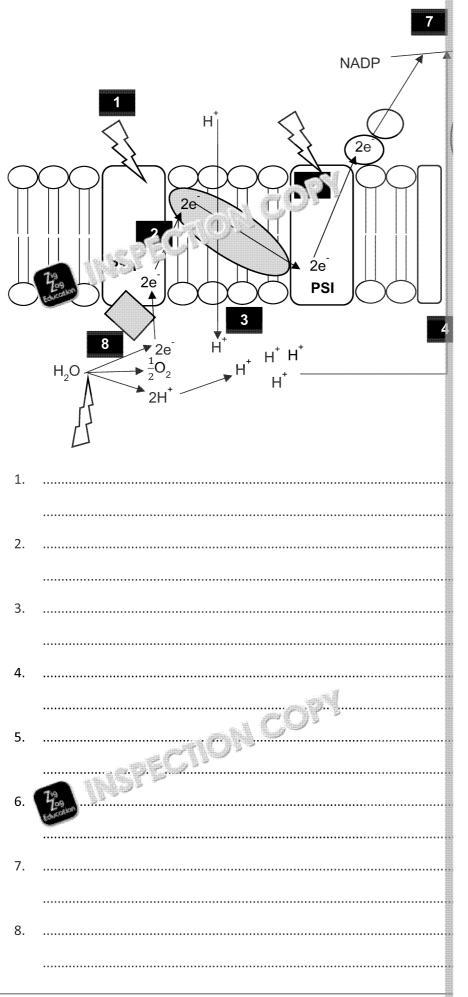
Light is absorbed by the chlorophyll and this excites electrons. This can hap photosystem – photosystem I – and result in cyclic photophosphorylation. Soth photosystems and result in non-cyclic photophosphorylation. Both pro non-cyclic photophosphorylation produces reduced NADP as well. We will non-cyclic photophosphorylation.

What does photopho	sphorylation mean? Bre Valle v	-
<b>a</b> 1115		
Fill in the gaps to desc	cribe the structure of the thylak	oid membrane.
The	membranes a	are found in large
They consist of a _		with specific
embedded, each of	which has a specific functio	n. There are pho
	to absorb light. I	There are electror
	These allow elec	trons to release t
that they contain.	There are also stalked partic	cles. These consi
to	ions, with an _	
	side. This enzym	e catalyses the fo
	from ADP and a	phosphate group
the process of	·	
Stuck? Use these mis	esing words:	
chemiosmosis	thylakoid	electron transp
hydrogen	chlorophyll	ATP
proteins	ATP synthase	stroma
To the state of th		

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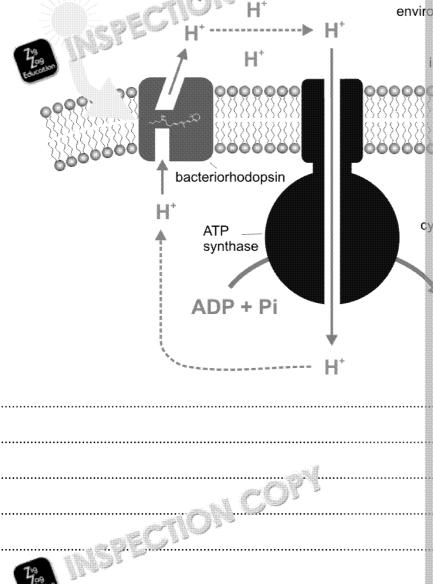
3. Describe what is going on at each of the numbered stages.



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### 



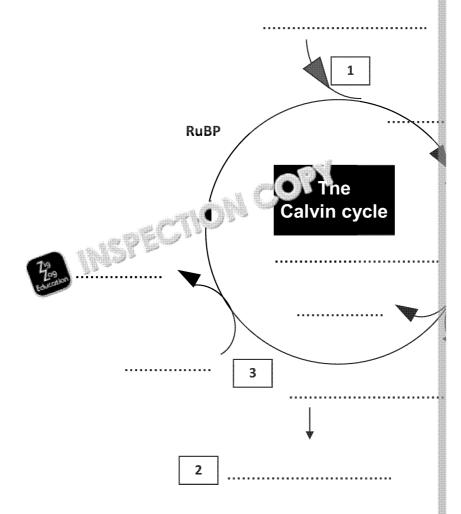
### Task 4 The light-independent stage

1.	Stat	te the two products from the light-dependent stage that are needed
	1.	
	2.	

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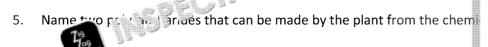
2. Complete the labels in the cycle below.



3.	What is	the	name	of the	enzyme	e needed	to	catalyse	the	step	labelled	1?

4.	This used to be called the dark stage.	Explain why that is not completely	
		e de la companya de	

G9°



2.	

6.	Describe what happens to most of the chemical next to label 3.

CO	PYR	IG	HT
PRC	)TE(	CTE	D



7.	Weedkillers often act by stopping the flow of electrons in the light-depen- would result in limited growth, or death, of a plant.	
Ta	sk 5 The rate of photosyn≒asis	
	The rate of photoses and state	
q	Limiting factors	
te fa	the rather synthesis is affected by several factors, the main ones be emper and light intensity. The factor that is at its least favourable vactor. If you increase the value of a particular factor, and the rate increase as limiting the rate of photosynthesis. The effect of these factors can be	
	ate of photosynthesis when one of the factors is changed.	
1.	For each of the three main factors stated, describe how it can affect photo	
	CO <sub>2</sub> availability:	
	Temperature:	
	Light intensity:	
		COPYRIGHT
ligh	e graph to the right shows the notation intensity on the rot. So, "en uptake.	PROTECTED
2.	State of oxygen uptake.  State of oxygen production is at point 1, and explain why.	<b>7</b> i9
	of oxyge	Zag Education
	Rate c	Loocation

ľa	k 6 Measuring the rate of photosynthesis
6.	What factors would need to be rue d in order to calculate a rate of o
5.	Why is the rate of oxygen production used as a measure of the rate of ph
4.	Sketch a line on the graph to show what the result would be of increasing
3.	What could be the limiting factor at point 2?

1. In task 5, we stated that the rate of release of  $O_2$  can be used as a measur It would also be possible to measure the uptake of carbon dioxide. Comp for, and one reason against, using these two measures.

	For	
O₂ uptake		
CO₂ release		





## 2. Extension – Plan an experiment to measure the effect of changing light int photosynthesis using a photosynthometer.

Diagram of apparatus:	
THE WORLD WITH THE PARTY OF THE	
In ent variable:	Dependent variable:
Method:	
Controlled variable	Но
	s table layout
es)	
to to the second	

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## Quick recap

Complete the table of definitions. After this exercise you should expand this to make a complete glossary.

The splitting of water using light

The enzyme that creates ATP

A series of proteins embedded in the thylakoid membrane

The enzyme needed to catalyse the fixation of CO<sub>2</sub>

Site of the light-independent reactions

Site of the light-dependent reason

Stack of the lake in the range

First standard of the fixation of CO<sub>2</sub> in the Calvin cycle

Final electron acceptor in the light-dependent stage

Increases kinetic energy

The flow of protons which results in the formation of ATP

A coloured chemical which absorbs some wavelengths of light

Used to separate chemicals from a mixture

## Extension

- 1. Compare and contrast photosynthesis and respiration. You may wish to u
- 2. Research what is meant by the endosymbiotic theory and then write a bri You may wish to use diagrams to help your explanation.



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## 8. Respiration

## Learning objectives

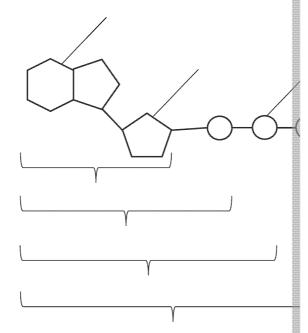
By the end of this lesson, you should be able to:

- Describe the structure of ATP, and explain its function
- Describe the stages of aerobic respiration including glycolysis, the link rea oxidative phosphorylation
- State the products of each stage
- Explain the importance of coenzymes with reference to oxidation and red
- Describe the anaerobic pathway and explain why is itilised
- Describe and explain the difference in AT production between aerobic re

## Getting going

1. Lak for

fol ving diagram of ATP.



- 2. Match the words to their definitions.
  - 1 ATP
  - 2 Substrate
  - 3 Enzyme
  - 4 Alpha gluc 🦟



- 7 Reduction
- 8 Starch
- 9 Oxidation
- 10 Glycogen

- A Carbohydrata monomer used as
- B / ... en int which contains one i
- The substance used in a reaction
- D The loss of an electron
- E Polymer of glucose found in anin
- F Produced in respiration, transfer
- G The gain of an electron
- H Does not require oxygen
- I Reduces the activation energy in
- J Polymer of alpha glucose found

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## The role of respiration

Respiration is a complex set of enzyme-controlled reactions which occur in mostly aerobic respiration, whereas some rely heavily on anaerobic respiration but there are some organisms which can only do anaerobic respiration, an aerobic respiration. The aerobic pathways start with a process called glycocytoplasm and converts glucose into pyruvate. The pyruvate is then active mitochondria where it undergoes the link reaction, the Krebs cycle and ox The end product of these processes is ATP, sometimes termed the energy transfers energy from respiration to energy-requiring processes within the transport, movement of chromosomes and organelles, and activation of processes.

## Task 1 The mitochord in.

3. Name a chemical which will normally be entering the mitochondrion.

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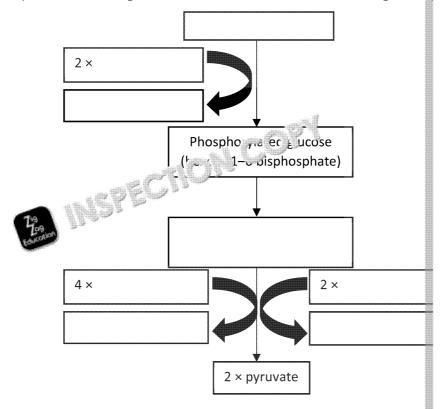
## 

## Task 2 Glycolysis

## An ancient pathway

Glycolysis is the first pathway to occur, whether the cell is carrying out ae: It is an ancient pathway that happens in the cytoplasm. It involves the paglucose (which contains six carbon atoms) into two molecules of pyruvate carbons). ATP is both used and produced, and reduction of a chemical call The reduced NAD is used in a later reaction — oxidative phosphorylation.

1. Complete the following flow chart to show the reactions occurring in the



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## For one molecule of glucose, what is the NET gain of ATP during glycolysis What is the coenzyme used in this pathway? 4. Synoptic – Describe the lock and key theory and the induced fit theory of Suggest what would happen to the reactions in glycolysis if there was no Explain why a suspension of mitochondria cannot carry out respiration w respiratory substrate.

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## The link reaction and the Krebs cycle Task 3

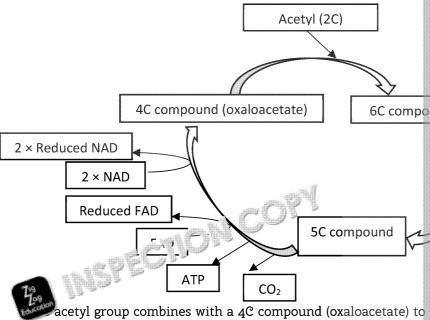
If there is sufficient oxygen (and it is a eukaryotic cell), the pyruvate from glyco matrix of the mitochondrion. There it will undergo the link reaction and the Kr

Using the following paragraph, construct a flow diagram of the link reaction Once inside the mitochondrion, the pyruvate is decarboxylated to release product. The resulting 2-carbon compound is oxidised by the removal by NAD, so producing reduced NAD. The 2-carbon compound is then acetyl coenzyme A.



Coenzyme A releases the 2-carbon compound (acetyl group) into the Kreb

Turn the following diagram of the Krebs cycle into a concise set of bullet c for you.



₿	************	 	***************	***********

•	 

• • • • • • • • • • • • • • • • • • • •

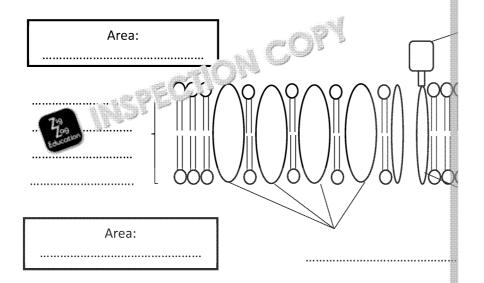


## Define the following terms: Decarboxylation Dehydrogenation Substrate level phosphorylation Suggest why living organisms only have small amounts of oxaloacetate in **Oxidative phosphorylation**

## Task 4

The reduced NAD and reduced FAD are now used to fuel oxidative phosphory ATP is generated.

Fill in the boxes in order to label the following diagram.



## ned ir elect the elect trix sine for openi

## The energy is used to pump the hydrogen ions from the matrix The H is split into protons and electrons. Oxygen also accepts protons, and, therefore, forms water. The hydrogen ions flow down the electrochemical gradient back specialised channel protein in the inner membrane. The electrons flow down the electron transport chain through releasing energy as they do so. NAD and FAD are oxidised, releasing the hand are reformed 1 The electrons in the ETC and act ated by oxygen (the final electrons) The elect accepted by the first electron carrier in the electron carrier in th This in more hydrogen ions in the intermembrane space electrochemical gradient. The channel protein has ATP synthase attached on the matrix s The flow of hydrogen ions through ATP synthase causes the for phosphate group – this is known as chemiosmosis. Add annotations to the diagram from question 1 to show what is happen Name the role oxygen plays, and explain why this is important. In some experiments to explore what is happening in this process, the out removed. Explain why this would cause ATP production to stop. Task 5 **Anaerobic respiration** Aerobic respiration produces more ATP replaced per glucose than anaerobic be able to produce some ATP using the macrobic pathway when oxygen levels What is the role of typen in aerobic respiration? Explain in detail what would happen if there was no oxygen.

Using the diagram from question 1 to help you, order the statements. The

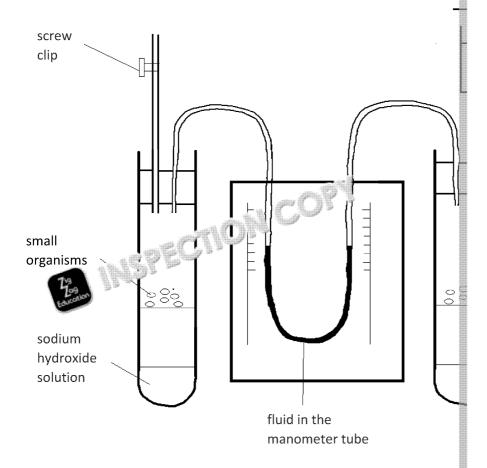


During anaerobic respiration, glycolysis still occurs. For glycolysis to continue, be reoxidised.

The Ultimate 'Task-Driven Independent Learning' Resource for A Level OCR Biology A Year 2

3.	Draw a flow chart to show how this happens in mammalian cells, and also	
	Mammalian cells:	
	Planytungal cells:	
4.	Explain why the yield of ATP per molecule of glucose is less than that of a	•
Ta	sk 6 Investigating respiration	
1.	Suggest why yeast is often used for exper me. * Investigating respiration	COPYRIGHT PROTECTED
2.	What are the factors that could affect the rate of respiration?	Zig Zag
		Education

A respirometer can be used to investigate the rate of respiration. Below is a di

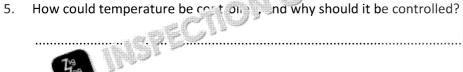


***************************************	

3.	What	is	the	pur	pose	of	the	sodium	hydr	oxide	:?	

4.	If the organisms are living and carrying out aerobic respiration, which	
	move? Explain why.	

\_\_\_\_\_CO<sup>83</sup>\_\_\_\_\_



6. Why should the taps be left open for 10 minutes before readings are take

***************************************	• 100
	- 33
	- 33
	- 33
	- #
	. 33

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Zig Zag Education

## Why should the mass of organisms be taken at the start? How is the manometer reset? If yeast was used instead, how could you adapt the equipment to measure Quick recap Fill in the gaps in the paragraph below. Respiration in cells can be aerobic or \_\_\_\_\_\_. Aerobic \_\_ and produces \_\_\_\_\_ ATP per mo anaerobic respiration does. Both start with the process of \_\_\_\_\_ glucose into \_\_\_\_\_ and produces \_\_\_\_\_ respiration pyruvate is actively transported into the \_\_\_\_\_ the link reaction and the \_\_\_\_\_ cycle occur. These pro The reduced NAD is reoxidised during oxidative \_\_\_\_\_ inner mitochondrial membrane. This is folded into \_\_\_ \_\_\_\_\_\_. This process uses a flow of hydrogen ions to p \_\_\_\_\_\_. Oxygen acts as the final electron \_\_ insufficient oxygen, the electron transport chain will stop and NAD \_\_\_\_\_\_. This means that the Kre' vcle and the link i In order to produce some ATP, reduced No. 2 in the \_\_\_\_\_\_ anaerobic pathway. ese ا الريان words: Stuck? oxygen phosphorylation matrix anaerobic pyruvate Krebs cristae reduced glycolysis ATP cytoplasm Extension Research the scientists who have contributed to the theory of all stages of rest about each scientist and what they contributed to the theory. Remember to

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## 9. Stem cells, mutations and ger

## Learning objectives

By the end of this lesson you should be able to:

- Define the term stem cell and define the different types of stem cells
- Explain how a stem cell becomes a differentiated cell
- Describe how induced pluripotent stem cells are created
- Discuss the therapeutic uses of stem cells
- Define the term transcription factor
- Describe how transcription factors control gene  $\epsilon = S$  ssion
- Explain how gene expression can be alter at collicing
- Describe and explain the lac one on so in example of control of gene explain
- Explain how mutation a cur, r.d their effects on gene expression and, the

## Getti பூர்வி

		ennin.
1.	Describe transcription in a single sentence.	
2.	Describe translation in as few words as you can.	
		***

## Differentiation

All humans begin as a single fertilised egg cell. This cell is a stem cell - it into any cell in the body. During development, the livides by mitosis, differentiate. This needs to happen in a vertical to led way to ensure that

In a full-grown adult, some to produce proteins to produce proteins to a tain times. All cells in the body have all of only nearly to sof it at a time

All of the eans that genes need to be turned on at certain times, and off development or as part of the day-to-day life of the cell.

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## Task I Stem cells

1.	What is the general definition of a stem cell?						

As stem cells begin to differentiate, their options become limited.

2. Complete the table to show definitions for the different types of stem cell each type.

	Cells '' (y , ) ifferentiate into	
	4 9 11	
ent		Cells of
	Several cell types	
Unipotent		Skin cell

3. Synoptic – Complete the table to describe two specialisations, and how th for each of the specialised cells.

Cell name	Function	Specialisation
Erythrocyte		
Neutrophil		
Squamous epithelial cell		

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4.	What does iPS stand for? Give a definition.	
5.	What is the advantage of using a person's own stem cells to grow an orga as fully as you can, thinking about the immune system.	
	<b>3</b> 133 E 3 3 2 3 3 3 2 3 3 2 3 3 3 3 2 3	
Ster 6.	n cells can be used for research into development, and for looking at how ce Explain how iPS cells can avoid some of the ethical issues involved in usin	
	for research.	
Ta	sk 2 Gene expression	
Sa	me DNA, different expression	CORVEIGHT
ma wh tra	adult cells with a nucleus from ividual will have exactly the san kes a cell in the retina beliave confirmity from a cell in the skin? The alether genes are a confirmity can be looked at at the transcriptional lensers are on or conscriptions.	
1.	What kind of molecule are transcription factors?	Zig Zag Education

## 2. Below is a diagram of an example of a stimulatory transcription factor, on Decide which of the labels goes where on the diagram. The first one has l

protein transcription gene promotor region translation 1 2 4 8 1. Transcription factor 2. 3. 4. 5. 6. 7. Use the diagram to produce a summary of how a transcription factor fund

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## Other transcription factors are inhibitory – what would be the difference Once the mRNA has been produced, a further level of control happens – s a) Intron..... Primary RN' Use the following diagram to suggest how alternative splicing from one gene. pre-mRNA alter translation protein isoform

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## Task 3 The lac operon and phosphorylation

The lac operon is an example of transcriptional control in prokaryotes. The back variety of sugars. If glucose is in the surrounding environment, it will use that If there is no glucose, but there is lactose, it can absorb and use lactose. In ord genes on.

1.	Name the monosaccharides that make up lactose.
	and and
2.	Name the bond that holds the two monosaccharides opether.
3.	Name the reaction the suit in two monosaccharides being formed from
4.	State what the following enzymes do:  Lactose permease
	Lactose permease
	Beta galactosidase

_	N 4 - 4 - I-	41		£	:		1			المائم المالم	c
5.	iviatch	tne	structures	touna	m	tne	iac o	peron	το	tneir	runctions.

***************************************						
1	Regulatory gene (I)					
2	Repressor protein					
3	Promotor					
4	RNA polymerase					
5	Operator region (lac O)					
6	Structural genes (lac Z and lac Y)					

Δ	When bound to
A	polymerase fro
В	Catalyses trans
D	phosphodieste
С	Codes for the
ח	Codes for the
U	and beta galact
F	Area where RN
	begin transcrip
	Where the rep

6. Order the following stater is who what happens in an *E. coli* bacter lactose present.

(La	The repressor protein binds to the operator region
	The enzymes are not produced
	A repressor protein is made
	The RNA polymerase cannot bind to the promotor region
	The regulator gene is expressed
	The structural genes cannot be transcribed

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## Now write your own set of statements for what happens when lactose is **Mutations** Define the term mutation. 2. Describe the difference between an insertion, a deletion and a substitution Describe what is meant by a frameshift mutation. 11375010

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## 4. A sequence of DNA is as follows:

DNA

mRNA

Amino acid

## TAC GTC GTC AAA AAT TCT TTA GGG

a) Compete the table to show the corresponding mRNA sequence, and for. You will need to use the following table of mRNA codons to amir

First Base										
	U			c			A			
	UUU		UCU			UAL	J		U	
	UUC	phe	ucc			UAG	=	tyr	UG	
u	UUA		UCA	s	er	UA	UAA	STOP	ij	
	UUG	leu	UCG			UA		CODON	U	
	cuu		ccu			CAL	J		Ct.	
	CUC		כרו			CAG	=	his	Cit	
(		1	CCA	— P	pro	CA	4	gln gln	C	
	JC G		ccg			CAG	ž		Cis	
	AUU		ACU		thr	AAl	J		AS	
Α	AUC	ile	ACC			AAG	=	4511	A	
	AUA		ACA			AA	4		ΑS	
	AUG					AAG	3	iys	A	
	GUU		GCU			GAL	J		G	
	GUC		GCC			GA	=	asp	G©	
b	GUA	Vai	GCA	ē	aia	GA/	٩		GK	
	GUG		GCG			GAG	3	giu	G	
TAC	G	TC	GTC		GT	C		AAA		
	C G TAC	UUUA UUG CUU CUC C C C C C C C C C C C C C C	UUC UUA UUG leu CUU CUC C C AUU AUC lie AUA AUG met (STA CODON GUU GUC GUC Val	UUC UCC  UUA UCA  UUG leu UCG  CUU CCU  CUC CCA  CCA  CCA  AUU ACU  AUC ile ACC  AUA ACA  AUG Met (START CODON)  GUU GCU  GUU GCC  GUU GCC  GUG GCC  GUA GCC  GUA GCC	UUUC UCCC  UUUA UCA  UUG leu UCG  CUU CCU  CUC CCG  AUU ACU  AUC ile ACC  AUA ACA  AUG Met (START CODON)  GUU GCU  GUC GCC  GCC	UUUA UCC SEP  UUUA UCA UCA  UUG IEU UCG  CUU CCU  CCCA  CCCA  CCCA  CCCA  AUU ACU  AUC IIE ACC  AUA ACA  AUA ACA  AUG FRET (START CODON)  GUU GCU  GUC GCC  GUC GCC  GUA GCC  GUG  GCC  GUA GCC  GCC  AUA  GCC  GCC  GUA  GCC  GCC	UUUA UCA SEP UAA UUA UCA SEP UAA UUG IEU UCG CUU CCU CAA CAA CAA AUU ACU AACA THE AAA AUA ACA THE AAA AUA ACA AAA AUA GUU GCU GAA GUU GCU GAA GUU GCU GAA GAA GUA GCA GAA GAA GAA GAA GAA GAA GAA GAA GAA GA	UUUA	UUC UCC Ser UAC  UUA UCA STOP  UAG CODON  CUU CCCU CAU his  CCCA CAA gln  CCG CAG CAG  AUU ACC ACC AAC  AUA ACC AACA AACA  AUA ACC AACA AACA	

For each of the following examples of a mutation to this sequence, describe effect of the mutation might be on protein function.

b)	TAC GTC GTC AAA AAC TCT TTA GGG	
c)	TAC GTC GTC AAA AGT TCT TTA 1G1.	
d)	TAC GTC GTC AAA ATT CTT TAG GG	

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## 5. Is there any situation where an insertion or a deletion would not result in could happen. Describe and explain how a truncated (shortened) protein might be produ ati is are harmful. However, some produce new alleles which and explain what would happen to the frequency of alleles in the a) a beneficial mutation a harmful mutation a neutral mutation

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## Quick recap

Complete the paragraph by filling in the gaps.								
Stem cells are cells that can divide and								
stem cells are found in the embryo an								
	cell typ	e. The use of these	e in research					
	issues.	Differentiation is	controlled by					
	, and	leads to						
to the shape of the	cell, or the pane							
blood cells have			vide more sp					
	****							
oxygen. s can	be switched on or	off by the binding of	or unbinaing					
	These	bind to the						
stimulate or stop tra	anscription of a pa	articular gene. Gene	e mutations c					
DNA. This can haj	ppen through		, deleti					
varying effects. If the amino acid sequence is changed, this changes t								
	structu	re of the protein, a	nd this might					
the protein as the will be affected.								
Stuck? Use the words	s below:							
specialisation tot differentiate a								

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## Extension

Write a mini essay on the following:

The importance of stem cells.

Remember to plan your essay first using a spider of at in, or something similar Your essay should include the following:

- A short introduction.
- Two or three topics is a stem cells, the choice of which is up to you.
- Link to a couch other if possible.
- Lini opics to the theme of the question why are stem cells import



## 10. Body plans, cloning and b

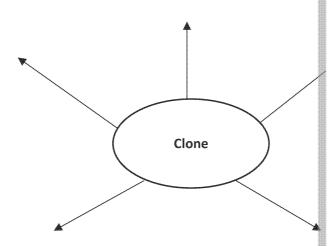
## Learning objectives

By the end of this lesson, you should be able to:

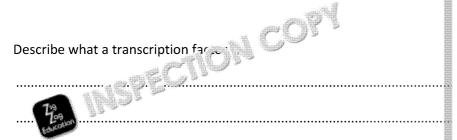
- Define the term body plan
- Describe and explain the role of mitosis and apoptosis in the development
- Explain the genetic control of body plans with reference to homeobox ger
- Define the term clone
- Explain how cloning can be carried out artificially in plants and animals
- Describe and explain the advantages and disadua at so of cloning
- Describe how microorganisms are used in biocannology
- Describe how to culture micra it fail in a lab with reference to aseptic
- Describe and explain the first and curve of a bacterial population in closed
- Described and explain the advantages of

## Gettirle going

Produce a mind map to show what you already know about clones.



~	<b>-</b>				
2.	Describe	what a	transcr	'Intion	tar
6m +	DUSCHING	vviiata	uansci	IDUIDII	1,000





## Task I Body plans

## **Body plans**

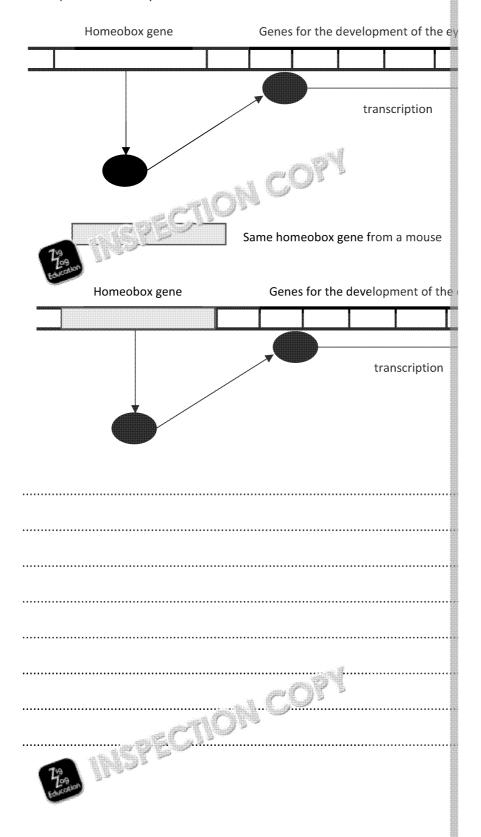
Organisms develop in a very controlled way. The fertilised egg cell first must ball of cells must become specialised. Some cells will become one type of tis other types of tissue. In addition to that, the ball of cells must become orgathe head end of the organism, and the other end becomes the tail end of the body plan, and is controlled by homeotic genes. Some of these gene sequence between organisms, giving evidence for evolution.

1.	Define mitosis.
2.	Complete the paragraph by filing in the gaps to show how body plans are
	Body are controlled by
	development of an organism – head t
	Some of these genes contain sequence
	base pairs long, and code for sections
	– the Th
	to other sections of DNA and initiate
	This sets off a cascade of gene expression – this led to the home
	called ge
	control which body part goes where – head to tail polarity.
	Stuck? Use the words below:
	homeotic master switches plans and transcription homeobox pro
3.	How many amino acids will that be a she homeodomain sequence?
4.	What of organisms are known to contain homeobox genes?
5.	Which type of organisms are known to contain Hox genes?

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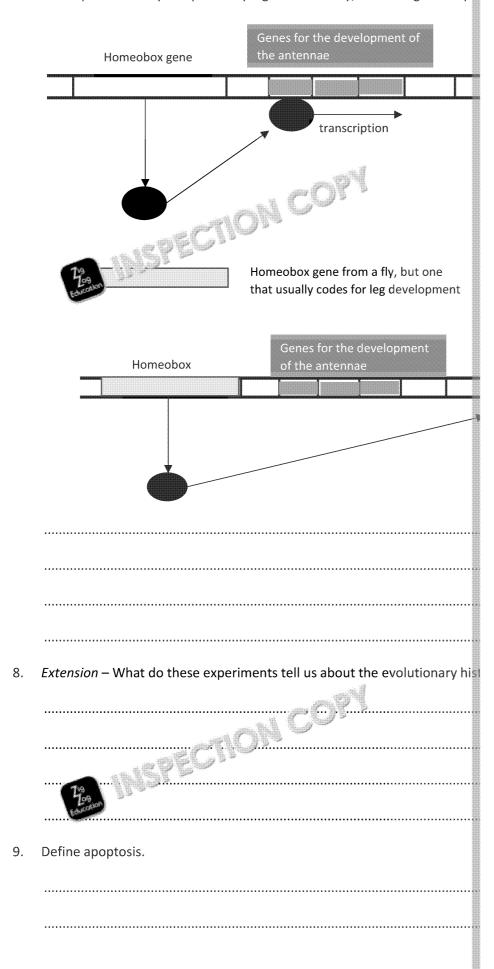
6. Use the following diagrams to explain what happens when a homeobox gousually initiates development of the eye in the fly is replaced by a gene from development of the eye in the mouse.



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7. Use the following diagrams to help describe and explain what happens we development in a fly is replaced by a gene from a fly, but for leg development



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## 10. Describe the role of apoptosis during development. 11. Suggest and explain the role that apoptosis has in children and adults. Plant cloning Task 2 Cloning Cloning can happen naturally or artificially. It happens naturally in many pl in animals. There are advantages and disadvantages to living organisms in c terms, plants can be cloned by tissue culture / micropropagation. Animals ar embryo splitting is quite successful. Again, there are advantages and disadva animals that can be cloned - there is the potential for non-reproductive clor Name the type of reproduction that produces clones. 1. 2. State three advantages of a plant carrying out cloning. COPYRIGHT **PROTECTED**

## Describe and explain why the lack of genetic variation might be a problem Name two ways plants can clone themselves naturally. Many genetically identify punts can be created artificially using tissue culture ing procedure was followed by a student. Identify three errors the procedure could be improved. Cut a small piece of tissue from anywhere on the plant and divide it Place these explants onto agar gel containing auxin and cytokinin. Leave the explants to grow into calluses. Move each of the calluses onto new agar plates containing auxin. Move the calluses again onto growth medium containing cytokinin. Allow the callus to grow into plantlets and then transfer to a greenho Error in step : ..... Error in step \_\_\_\_: ..... Improvement: ..... Error in step\_

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## Task 3 Animal cloning

and gro	technique known as embryo splitting, clones of animals are prod sperm from the bull. These are then used for in vitro fertilisation wn into an embryo. The embryo is divided into several parts, and y. The embryos grow inside the surrogates, and the calves are bo
a)	By what process are the eggs and sperm cre
b)	By what proces the tertilised egg cell become a ball of cell
c)	He calves that are born – which animal are they clones of?
d)	Explain why the embryo can be split into separate parts, and each
bull	et points.
	Ovum (egg cell) from sheep A
n	cell) from
n	cell) from sheep A  cell from the nammary gland

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## What is a somatic cell? Which sheep will the offspring be a clone of? Describe what non-reproductive cloning is. 7. wing arguments for cloning in animals, suggest what pryos are used in research into the effects of various factors. If the then the differences in response cannot be due to the genotype. There is the possibility to clone members of rare or endangered specie A herd of clones could be produced, all therefore showing a particular

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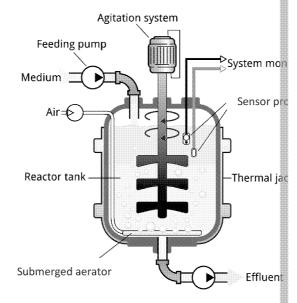
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## Task 4 Biotechnology

1.	Stat	e three reasons why microorganisms are particularly useful in biotec
	1.	
	2.	
	3.	
	٥.	

The organic can be own in huge vats to allow them the perfect growth conferment or which is shown below.



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## 2. For each of the features stated below, state what it is for, and explain wh Sensor probes for pH b) Aerator Thermal jacket Explain why all inlets will have filters on them. Describe the difference between batch culture and continuous culture.

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## Task 5 Culturing and counting microorganism

Whenever microorganisms are being grown for the purposes already discussed microorganism is allowed to grow – this requires the use of aseptic techniques unwanted bacteria.

L.	Expl	ain why it is important that there are no unwanted microorganisms.
	en lo lly-li	oking at the local arms in a lab setting, they are usually grown either table a gar – which has been melted, poured into Petri dishes
2.		ore beginning any practical, all equipment and the agar should be ster
<b></b>		ipment that is usually used to carry this out.
3.		four aseptic techniques that need to be adhered to when growing mi
	1.	
	2.	
	3.	
	4.	

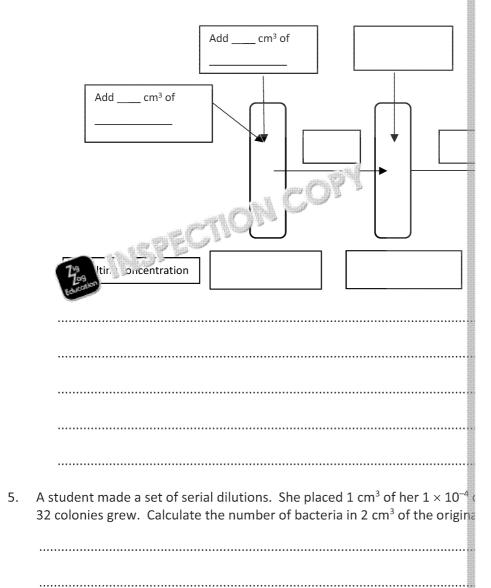
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## **Counting colonies**

Inoculation is the term is a to learlibe the transfer of microorganisms of this can be done in a most of ways depending on what you are wanting population of the broth onto the number of that grow. However, there may be too many colonies perform a serial solution first.

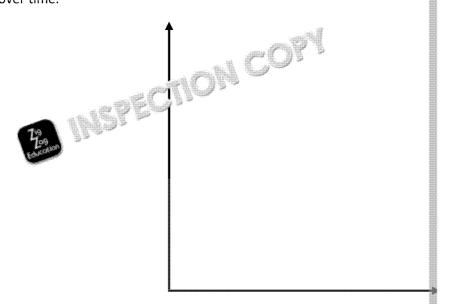


## 4. Complete the following diagram to show how to make a set of 1 in 10 seri concentration of each resulting solution.



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The student used her data to plot a growth curve for the bacteria. Sketch
happen to the population of the bacteria in closed culture in a Petri dish (
over time.





7. Match the growth stage to the description of what is happening.

А	Lag
В	Log
С	Stationary
D	Death

	1	Each bacterium has suffic
		is rapid, the population in
	2	Complete lack of nutrients
	<i>I</i>	waste products
	3	Cells are taking up water,
	3	proteins. Little cell divisio
	А	Nutrients are decreasing a
	*	Death rate is equal to rep

A batch culture is effectively a closed culture is population is allowed curve. Describe and explain what type of hetailolites are harvested from

## Task 6 Immobilised enzymes

Some products that are being produced by biotechnology don't require whole just extract the enzyme required from that microorganism, and allow the subsenzyme. This could just be in a test tube, but the process is improved by immore

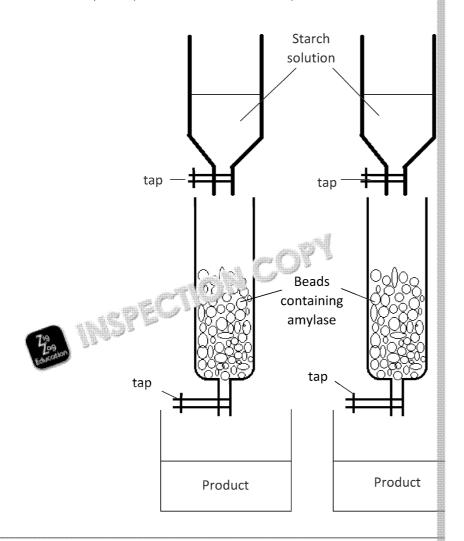
L.	Des	scribe the lock and key hypothesis of enzyme function.
	****	
	****	
2.	a)	If an enzyme and a substrate are allowed to mi, reely in a test tube reaction has finished?
	b)	issue does this cause?
		••••••••••••••••••••••••••••••••

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### Fill in the gaps to describe three methods of immobilising enzymes. 3. Enzymes can be immobilised in several ways. In all ways, the enzyme must be available to the \_\_\_\_\_\_. \_\_\_ enzyme being bound to an inert substance, such as clay, by ionic interactions. This might distort the \_\_\_\_\_ of t are not strong bonds and so might be \_\_\_\_\_ \_\_\_. Another appearing mixed in with the \_\_\_ onding – the enzyme can still bound by \_\_ bonds are \_, it is less likely that the enzy \_\_\_\_\_ in a matrix. This doe ethod is \_ enzyme in any way, but the substrate will need to \_\_\_\_\_ **Stuck?** Use the words below: substrate entrapment broken covalei shape stronger adsorption produc

A student wants to compare the speed of reaction between two immobilised e from two different yeast species. The student sets up two columns as shown k



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4.	In order for the student to be able to make valid comparisons between the would need to be controlled:	
	1	
	2	
	3	
5.	Describe how the concentration of the product could be measured.	0
6.	Explain two advantages of using immobilised amylase rather than free an	
	1	
	2	
<b>(</b> 91	ıick recap	
	ine the following terms:	
a)	Adsorption	
<b>L</b> )	Loginhoso	COPYRIGH
b)	Log phase	PROTECTED
c)	Asensia	
~,		
d)	Continuous culture	<b>7</b> 9
٠		Education
e)	Biotechnology	

### f) Cloning g) Auxin h) Micropropagation i) Homeobox genes Extension

er to advertise and promote products made from mycoprotein.

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### 11. Inheritance

### Learning objectives

By the end of this lesson, you should be able to:

- Define the terms chromosome, gene, allele, genotype, phenotype
- Predict the outcome of monohybrid crosses involving dominant and reces traits and sex-linked traits
- Predict the outcomes of dihybrid crosses
- Explain the results of a cross involving autosomal linkage and epistasis
- Interpret pedigree diagrams
- Use a chi-squared calculation and integor it the esults

### Getting going

1. Ma tens to their definitions.

	- 1.65° /-
1	Nucleus
2	DNA
3	Gene
4	Chromosome
5	Diploid
6	Haploid

Α	Molecule that forms a double
В	A length of DNA that codes fo
С	A cell with a single set of chro
D	A linear DNA molecule wrappe in the nucleus
E	The organelle which contains molecules
F	A cell with two sets of chromo

### **Inheritance**

We all possess many different traits. Some of these traits are inherited fro influence from the environment, whereas others are heavily influenced by Gregor Mendel did much of the early work on how we inherit traits from the father of genetics. His work led to a much greater understanding of inpredict the outcomes of crosses between particular parents.

### Task I Genes and chromosome

1. Complete the table by defining  $s \dots t$  potent terms for inheritance.

Homologous	
Lo 2	
Allele	
Genotype	
Homozygous	
Phenotype	

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Heterozygous	
Dominant	
Recessive	
Protein synthesis	

2. In the boxes below, complete a set of labelled diagrams to show what has division of meiosis. Start with a cell that has two pairs of chromosomes.

		-
- 4	10	
	12	9
1	2.4.1	dille"

Prophase 1

form. Chiasmata occur.

### Metaphase 1

Pairs of homologous chromosomes align on the equator, still attached to each other at chiasmata. They are attached to the spindle by their centromeres. They align independently of each other.

The chromosomes condense and bivaler

### Anaphase 1

One chromosome from each pair moves to each pole, pulled by the spindle fibres. The chiasmata separate.

### Telophase 1

Chromosomes arrive at the All Steach pole has one of or a likew nuclear envelopes it





### How is meiosis 2 different from meiosis 1? Task 2 Monohybrid inherita: Genetic rules When I g the inheritance of one gene, we call these crosses monoh straightenant traits which have two alleles, one of which is dominant an However, they can be more complicated when the gene is codominant, sex As long as you notate your crosses correctly, and follow the rules, you will General rules: Every gene on autosomal chromosomes has two alleles in each individual two alleles to choose from though. Each allele is given a letter. When the trait has only two alleles which the same letter is used – upper case for the dominant, and lower case R and r). Be careful with the letters that you choose! Codominance – in this case neither of the alleles is truly dominant over heterozygote shows an intermediate phenotype. Sex linkage is concerned with the inheritance of genes which are carri When there are more than two alleles for a particular gene, it is said 1. Cystic fibrosis happens as a result of a person having two recessive alleles determine what the chances are of two parents heterozygous for cystic fill recessive child. Use the letters F and f for the alleles. Parental genotypes: Gamete genotypes: Offspring genotypes: Offspring phenotypes: Ratio of unaffected to affected offspring:

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Answer to the question:

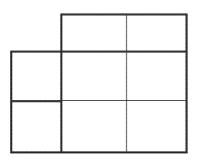
- Palomino horses are much sought after by horse breeders, but they do no crossing a chestnut (CH CH) with a cream (CC CC); the resultant heterozygot codominance. Draw genetic diagrams to show the crosses between:
  - A chestnut horse and a cream horse

b)	Two pa	lomino	horses
U)	I WO Pai		110136



Haemophilia A is an inherited condition whereby a person cannot produce for the blood clotting process, and the gene for this is on the X chromosor inheritance of haemophilia when the father is normal and the mother is

Parent genotype:	
Gamete genotype:	 



### Offspring phenotypes:

### Dihybrid inheritance Task 3

### Investigating two gen

We can look at the same time. Obviously, each i wai in is just looking at the inheritance of two of them. We I did a lot of work on what happens, and worked out what the would be when crossing various sets of parents.

When Mendel crossed true breeding pea plants with yellow and round see with green and wrinkled seeds, all of the offspring were yellow and round. yellow or green – and the B gene codes for shape – round or wrinkled.

REMEMBER: in these crosses, the gametes must have one copy of each

# 



Parental genotypes AABB aabb Gamete genotypes AB ab

	АВ
ab	AaBb

1.	What process produces the gametes?
2.	All of the offspring were volume in round – what does that tell us about
3.	Mendel then crossed two of the F1 generation together. Complete the connected outcome

3.	Mendel then crossed two of the F1 generation together.	Complete:	the c	
	expected outcome.			

Parental genotypes:	
Gamete genotypes:	

Phenotypes:	









### Task 4 Autosomal linkage

### Genetic interaction

So, what happens if we don't get the ratio that we expect in a dihybrid crost two genes are not being inherited independently of each other, or that they

1.	What is an autosomal chromosome?
2.	Define what it is a liby autosomal linkage.
3.	Two genes in a fly are gene Y and gene R. These are linked genes – Y cod R codes for long antennae, r for short. If two double heterozygotes (YyR weren't linked, we would expect to get a roughly equal number of four p the gametes – YR, Yr, yR and yr.
	Explain why we don't get equal numbers of these gametes.
4.	What process allows us to get all four combinations, although not in the
5.	Complete a cross between a double heterozygote and an individual show question 3. In what ratio would you expect the offspring if the two gene
	Parental genotypes:
	Gametes:
	Phenotypes:
	Unlinked expected ratio:

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In fact, when this cross happened, the following results were obtained:

Phenotype	Number of
Yellow wings and long antennae	568
Red wings and short antennae	529
Yellow wings and short antennae	124
Red wings and long antennae	135

Use the idea of linkage to explain why these offspring are not in the ratio		

### Task 5 Epistasis

### **Epistasis**

Epistasis also results in unexpected ratios. Epistasis is where one gene affection controlled by two genes at different loci. Gene B controlled and pigment, with the dominant allele resulting in pigment. Gene pigment, with black being recessive and agouti being dominant. Agouti is a So, gene A can only be expressed under certain conditions of gene B – gene gene A.

1.	. Give all of the possible genotypes of an agouti mouse.	
2.	If two double heterozygotes were crossed, who would the expected ratio b	





3.	Use the Punnett square outline below to show what ratio would be expe
	were crossed, and the genes do show epistasis, as described in the information
	which genotypes lead to which phenotypes.

<u> </u>	

4.	Suggest and explain how the gene products could produce this effect.

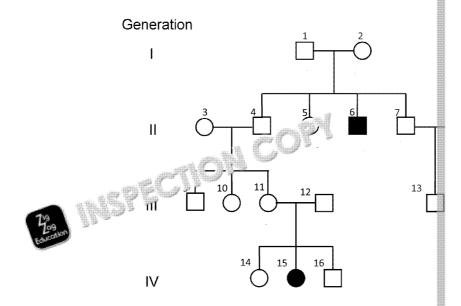
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### Task 6 Pedigrees

Pedigrees, or family trees, can be used to show the inheritance of traits through squestions, they often ask how they can be used as evidence that a particular trait



Square = male, circle = female

Shaded = affected, unshaded = unaffected

1. If we assume that this is a disorder caused by a recessive allele, using the of the following individuals:

State one piece of evidence which shows that this is a recessive disorder

- a) 1 \_\_\_\_\_
- b) 6\_\_\_\_\_
- c) 11 \_\_\_\_\_
- 3. State one pig a state one p

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### Task 7 The chi-squared test

### Observed and expected

When looking at crosses between two individuals of known genotype, if we inheritance, we can predict what the ratio of phenotypes in the offspring scarrying out the cross there may well be hundreds of offspring. If you are you get 51:105:49, is this close enough to the ratio to accept? The chi-sq decision for you. This mathematical calculation is used to assess whether between observed and expected numbers.

$$\chi^2 = \sum \frac{(f_o - f_e)^2}{f_e}$$

- 1. What is d c is a sould we use with the chi-squared test?
- A dihybrid cross was carried out between two double heterozygotes. One for leaf colour.
  - a) What is the expected ratio of offspring if we assume there is no linka;
  - b) The cross was carried out and there were 86 plants with purple jagge smooth leaves, 26 plants with green jagged leaves, and 8 plants with the ratio, how many should we have expected in each class of offspri

Purple jagged.....

Green jagged.....

Purple smooth.....

Green smooth.....

c) Calculate the chi-squared value. You can use the table below to help

Phenotype	Purple jagged	Green jagged	Purp
Expected ratio			
Expected number			
Observed u & "	86	26	
i <sub>o</sub> – f <sub>e</sub>			
$(f_o - f_e)^2$			
$(f_{o} - f_{e})^{2} / f_{e}$			

Chi-squared value:.....

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3. In another cross, the two genes being looked at were for seed shape and data again, and the chi-squared value that was calculated was 1.35.

Use the following table to find the critical value, and then circle it. Remenare calculated by the number of classes – 1.

Dograps of freedom		Probability greater
Degrees of freedom	0.1	0.05
1	2.71	3.84
2	4.60	5.99
3	6.25	82
4	7.78	9.49

4.	Now use the critical version to verse a conclusion.	
5.	In another cross, the p value was calculated at $p = 0.04$ . What conclusion	
Qι	ıick recap	
1.	Give definitions for the terms below.	
	Genotype:	

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Dominant:
Codominant:
Recessive:
Autosomal linkage:
Sex linkage:
~~·············

Phenotype:.....

### 2. Complete the following cross:

In pea plants, the allele for tall plants (T) is dominant to the allele for dwaldiagram to show the expected genotypes and phenotypes of offspring in a

### ZUTTO EOZ COT

3. In class, coat colour is controlled by two alleles which are codominant black, homozygotes for the other allele are white, and heterozygotes are diagram to show the expected genotypes, phenotypes and phenotypic ratwo chequered chickens.

4. In humans, one form of colour blindness is a sex-linked recessive genetic to show the expected genotypes and phenotypes between a carrier moth

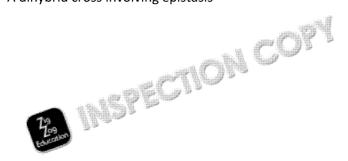




### Extension

Carry out some Internet research to find one different example for each of the be able to do:

- A monohybrid cross with just dominant and recessive alleles
- A monohybrid cross involving codominance
- A monohybrid cross involving sex linkage
- A dihybrid cross with no linkage or epistasis
- A dihybrid cross involving linkage
- A dihybrid cross involving epistasis





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### 12. Manipulating D

### Learning objectives

By the end of this lesson, you should be able to:

- Describe and explain how to clone a gene through the process of PCR
- Describe the role of restriction endonucleases
- Describe and explain the process of electrophoresis
- Explain how a DNA probe works
- Describe and explain how to clone a gene using genetic engineering (in viv
- Explain how a genetically engineered organism called press the gene it has
- Explain how amino acid sequences of a plate, an be determined using a

### Getting going

Dra	lar Gradina nucleotide in the box below.
Name the	e bond that forms between the sugar and the phosphate in D
ivaine circ	, bond that forms between the sagar and the phosphate in b
Name the	e enzyme that joins the sugar phosphate backbone in DNA rep
	. , ,
Name the	e bond that holds the two strands of DNA together.
What is m	neant by comple t' a_e pairing?
4	(1,1/2,3)*
N2	
• • • • • • • • • • • • • •	

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### Manipulating DNA

This set of tasks is based around methods that are used to locate and iden make more copies of that piece of DNA, and sometimes add that piece of get it to express the gene. When investigating this, there are several technologies techniques are used in several situations, so they can come up in excombined with each other.

A patient is being looked after by the genetic screening department. They the patient has certain alleles for some genes, and also what proteins those A sample of cells will be taken from the patient, and then the following steeps.

- 1. Extraction of DNA from the cells
- 2. Cloning of the DNA to make property of the power cloning
- 3. Digestion of the DNA .... + Jus
- 4. Separation of t': 20 12. Ections by electrophoresis
- 5. Idamica 1. C'known sections by the use of probes
- 6. Sing of unknown sections
- 7. Use the sequences to predict the amino acid sequences of the prote

### Task I In vitro gene cloning – the polymeras

The polymerase chain reaction was developed by Kary Mullis. In the first instate the application of the technique. It is now used on a daily basis in most laborate have all now heard about it thanks to COVID. It is a series of heating and cooling identical copies (clones) of particular sections of DNA being produced. Firstly, DNA to be copied, DNA nucleotides, primers, DNA polymerase.

1. Complete the table to show the reasons for each step of the process.

	Step	
1.	The sample is heated to 95 °C	
2.	The sample is cooled to about 55 °C	
3.	The sample is heated to about?	
4.	3 are repeated about 30 times	

2.	What is the function of the primers?

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3. Complete the following table to compare and contrast DNA replication, tr the boxes to show which process/processes involve/s which feature.

### Pro **PCR Feature** DNA re Involves DNA polymerase **Produces DNA** Occurs in the nucleus of cells Involves heating and cooling H bonds are broken H bonds are formed Needs free nucleotides Involves the formation phosphodics to ds rimers Needs tree nucleotides **Produces RNA**

4.	If starting with a single piece of DNA, how many pieces would there be a
5.	Suggest and explain the implications of a random mutation occurring in t

### Task 2 Digestion and separation of DNA

The samples of DNA to be analysed will need to be digested into smaller fragments of different lengths.

1.	Name the enzyme that digests the DNA	into smaller fragments, and	l expl
	specific way.		

specific way.	
Enzyme:	
Explanation:	
If there are two samples of DNA, both from the same person, what can produced if using the same enzymes during digestion?	y¢

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2.

### In the process of electrophoresis, which electrode are the DNA pieces put Why does the DNA move the control egel? Explain how this process separates a mixture of DNA strands of different During a forensic investigation, the following DNA fingerprint/profile was obtain B and C are suspects for the crime. В C What can you conclude about suspects B and C?

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Genetic fingerprinting can also be used in paternity testing. The following was M is the DNA from the mother, Ch is from the child.

### Father M Ch 1 2 3

7.	Discuss which c a 'ers, 1–3, is most likely to be the father of the chi
8.	In modern tests, not all of the DNA is used to analyse similarities and differentiations are used, and explain why this will still work.
9.	Extension – This process can also deseparate proteins. By what f

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### Task 3 Probes and proteins

In our original example, DNA from a patient is being analysed to see whether t certain gene. So far, the DNA has been copied, digested and separated out int to identify a particular sequence of bases. Probes are short, single-stranded set the section being looked for.

A sequence of DNA being analysed is as follows:

### ATCGTGATGCTAGTCAATCGATCCTGA

1.	We want to know whether it contains the sequence CATGC. What sequence
2.	What needs to be attained for the probe in order to make it visible?
3.	Why must the DNA be single-stranded for this to work?
4.	Extension – How is DNA made single-stranded?
5.	Why is washing the DNA after adding the probe important?

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Probes can be used to identify specific alleles within individuals. This informat patients about health risks, drug responses and heritable conditions.

6. Cystic fibrosis is a heritable condition – it is caused by the presence of two individual. Two individuals who are thinking about conceiving a child both their family. They choose to undergo genetic testing to see whether they

Parent 2

Parent 1

a)

b)

	OPM	complemen
		complemen
State the genotype of each parent.		
Parent 1:		
Parent 2:		
Describe and explain what advice would	be given to the	couple by a

Explain why the band for parent two is the train the equivalent ba

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Key:



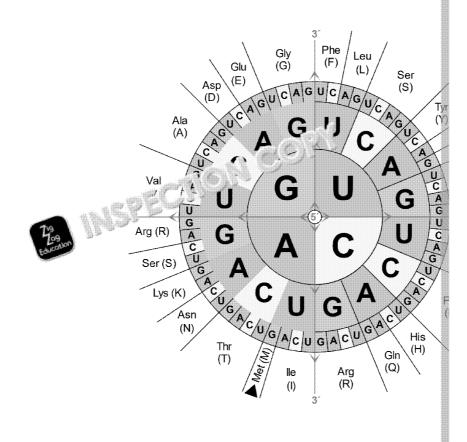
### 7. Synoptic – Complete the paragraph by filling in the missing words to describe protein synthesis. A section of DNA is unwound and free \_\_\_\_\_ \_\_\_\_\_ catalyses the formation of \_\_\_\_ between RNA nucleotides. This forms from DNA and leaves the nucleus through a \_\_\_\_\_ h :h holds two arrives at a \_\_\_\_\_ mRNA at a time. A tPATA viriate complementary \_ \_ bonds, bringing acid. A second tRNA molecule binds to the second codo specific to that tRNA. The two amino acids are joined by a \_ bond. The ribosome moves down the mRNA until a \_\_ is reached. **Stuck?** Use the words below: hydrogen specific phosphodiester codons ribosome RNA polymerase anticodon mRNA 8. If a protein has 456 amino acids in its primary structure, what is the mining must have contained? 9. Why might the DNA have had more bases than the answer to question 8?

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10. Using the diagram below, predict the amino acid sequence which would be base sequence. Work from the centre outwards. The diagram uses the management of the sequence which would be base sequence.

### TAC GGT AGG ACC GTG CGT ACT



### Task 4 In vivo gene cloning and protein prod

### Genetic engineering

Another way to clone genes is by the process of a vivo gene cloning, quite engineering. In this process, scientists will a the following steps:

- 1. Isolate the gene to be sione
- 2. Insert the gen la a sector
- 3. Ge ec c lo a host cell

This how will then replicate the inserted gene every time it replicates, the gene.

This technique is often used to go a step further – to get the host cell to exproduce the protein coded for by the inserted gene. This is how human inst

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1. Complete the table to show the process of genetic engineering. Use the ifrom the genome as the isolation technique.

### Diagram Chromosomal DNA fragment to be cloned: rechold co? A DNA plasmid from a bacterial cell Restr stagge If the used A will ha sticky The pl bacter up the

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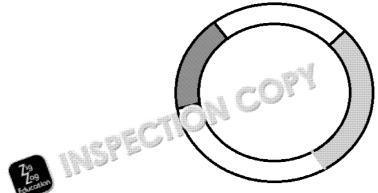
### Complete the following flow diagram to explain another method of isolati 2. mRNA is isolated from a cell which \_\_\_ \_\_\_\_ is used to add a complementary stran The RNA is \_\_\_\_\_\_ leaving a single-stranded piece The resulting single single and nucleic acid is turned into a double enzyme \_ are added to the resulting Draw an annotated picture to show the three possible types of bacteria the (Remember that the sticking back together is random, and that transform

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In order to identify which bacteria are which, the plasmid that was used contain were antibiotic resistance genes; now there are other genes which are used.

4. A plasmid that was used in the process contained two genes – resistance tetracycline. Use the following diagrams to explain the process of replica resistance genes.



The plasmid contains two antibiotic resistance genes – one gives resistance resistance to tetracycline.

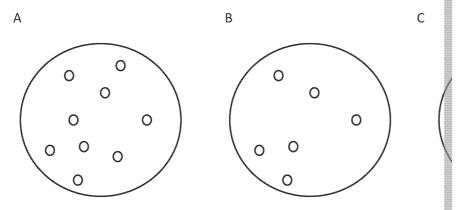


Plate A is normal agar, plate B contains the antibiotic ampicillin, and plat	

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### 5. In order for the bacterium to produce the protein that the gene codes for plasmid, and why?

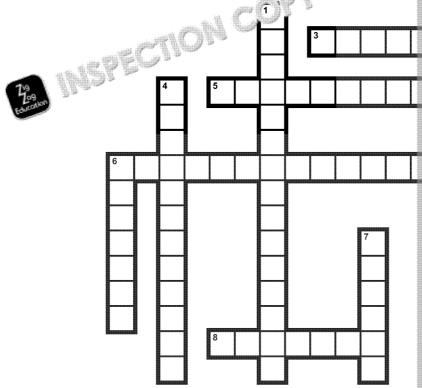
Added: .....

Explanation: .....

.....

### Quick recap

Complete the crossword below.



### Across

- 3 Used to transfer genes from one organism to other organisms (6)
- 5 A term to describe DNA that originates from two organisms (11)
- 6 The bond that joins adjacent nucleotides in a chain (14)
- 8 Short sections of DN<sup>Λ</sup> d signer to be complementally to an exact of a

### Down

- 1 Used to separate DN
- 2 Reverse \_\_\_\_, an enzy DNA from RNA (13)
- 6 A small circular piece
- 7 The name of the enzy together (6)

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### Extension

- 1. Research how a gene machine works.
- 2. Research the genetic modification of soya beans.
- 3. Produce a poster to show the pros and cons of genetic manipulation.
- 4. Produce a mind map to show how all of the aspects of this topic weave to

### 13. Measuring ecosys

### Learning objectives

By the end of this lesson, you should be able to:

- Define the key terms
- Describe how energy flows through an ecosystem and explain how energy
- Define productivity and explain the difference between gross productivity
- Describe how nitrogen is cycled within an ecosystem
- Explain the importance of microorganisms in the cycling of nutrients with
- Describe how to carry out ecological sampling
- Calculate the Spearman's rank and t-test

### Getting

1.	Ехр	lancine following statements:
	a)	Ecosystems are dynamic.
	b)	Matter is constantly recycled within ecosystems.
	c)	Energy is not recycled.
2.	Wh	at is meant by the terr and the evel?
	••••	

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		5 10
, Mas		29
1.00	m	2
	75	m

An ecosystem is defined as all of the living (biotic) and non-living (abiotic) particular time which interact with each other. Living organisms within the order to survive. Producers and consumers obtain this energy in different can be represented in different ways. The efficiency of the transfer is varied the transfer as efficient as possible by improving productivity. Gross primary of energy that plants are able to absorb and harness into chemical energy. It is a very inefficient process considering the amount of energy coming from

### Task I Energy transfer

1. Complete the table by defining the key terms.

Term	Definition	E000
Habitat		
Niche		
Population		
Community		
Ecosystem		

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### Explain the difference between a producer, a consumer and a decompose Complete the boxes in the following low chart of energy transfer. Light is \_ and some Energy transduced in produce glucose Glucose used energy left in plants Some mate Chemical energy ingested by Some Chemical energy digested by consumers Respiration Chemical energy used for What do the arm is on me diagram represent? Write an equation to show how to work out NPP.

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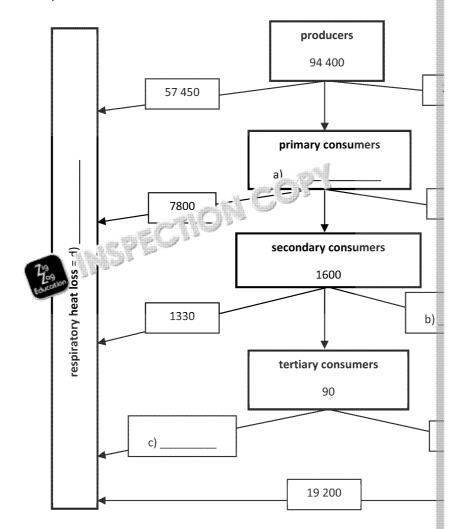


### Now explain, in words, the difference between the gross primary product primary productivity of an ecosystem. Suggest appropriate units for primary productivity a. The productivity of her crop plants. Suggest a Farmers rearing livestock also look to increase productivity – the secondary pro this is by rearing livestock indoors. This reduces heat loss and losses due to me secondary productivity being increased. These methods might not increase the profits that the farmer makes as m explain reasons why. 11375010

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10. Calculate the values a) to e) in the diagram below, which shows the amou an ecosystem.



, in the second

11.	Calculate the percentage efficiency between the secondary and tertiary	c

### Task 2 Sampling techniques

### Estimating populations

In order to be able to use these samples to calculate organism. In order to obtain representative samples, we must avoid bias as by random sampling. It's easier for plants because they don't move around



### Produce a set of instructions as to how to use sampling in order to obtain species within a particular area. Make sure you address the following issu Avoiding bias Representativeness of samples Defining the area Presentation of results Use of maths 2. An alternative method for recording species is the ACFOR scale. The person abundant, common, frequent, occasional or rare. State a limitation of this 3. A student wanted to find out how the distribution and abundance of plan under a tree out into an open area away from the tree. How would her sa method in question 1?

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### Task 3 Statistics

### Analysing correlation

Deciding whether there is a relationship between a factor and the distributhe mean number of organisms is significantly different in two areas, is suused to make the decision for us. The Spearman's rank correlation coefficible used in different situations.

Spearman's rank is used to determine whether there is any significant confirstly, a null hypothesis is made. This assumes that if e theory you have significant correlation. +1 indicates perfect results in order to relation, -1 indicates and o means no correlation.

A student carried so pling on a transect. The following data was gathered plants a light intensity at the time of doing the transect.

Quadrat number	Number of dandelion plants	Light intensity (lux)	Rank of dandelions	Rank of lig
1	2	150		
2	5	145		
3	6	270		
4	4	280		
5	10	500		
6	8	720		
7	9	1000		
8	12	1498		
9	15	1888		
10	22	2000		

	_section
2.	Cor the table, then use the data and the following equation to calcu
	$r_{S} = 1 - \frac{6 \sum d^{2}}{n(n^{2} - 1)}$

What would be the null hypothesis?



			conclusion can	
Number of pairs	7	8	9	
Critical value	0.79	0.74	0.68	
Ca.				
E.				*****
How could the inves	tigation be im			y of
How could the inves	tigation be im			y of
How could the inves	tigation be im			y of <sup>.</sup>

Another investigation looked at the height of a particular species of plant foun are shown below. This is an unpaired t-test as the two sets of data are from di when comparing two means.

Individual	Area A height (cm)	
1	54	
2	56	
3	57	
4	59	
5	62	
6	,5t	
7	58	
8	71	
9	47	
	53	
Mean Mean		

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### Calculate the mean for each set of data, and enter the two values into the Write a null hypothesis for the investigation. d deviation for each set of data using the formula be Now calculate the t value. $S_A$ is the standard deviation for area A, and $S_B$ The degrees of freedom are c | united by: $df = n_1 + n_2 - 2$ . What are the c 10. In another investigation, the p value was calculated at p = 0.04. What con

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### Task 4 The nitrogen cycle

### The need for nitrogen

Most of the nitrogen in the ecosystem exists as  $N_2$  in the atmosphere. Due unreactive and most organisms cannot use it in this form. About 80 % of the nitrogen gas, and we just breath it back out again without being able to use that can break the bonds in a nitrogen molecule – certain species of bacter cycling of nitrogen atoms through ecosystems, and their roles include nitrodenitrification. There are also many other bacteria and fungi involved in desaprobionts (saprotrophs).

1. Draw and label a hand of him the box below.



2.	State two	biological	l macromo	lecules that	contain nitroger	١.

1.	 	 	 

2	3
<i>L</i> .	 2

3.	Describe how n	itrogen gets	into the	biological	molecules	of animals	from
		8 8					

4. Describe what a municipie crationship is. Try to find an example to sup



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### Below is a simplified version of the nitrogen cycle. What is represented by b: d: compounds in legumes Nitrogen compounds in anii Nitrogen compounds in other plants Nitrogen compounds in the so Nitrate ions By what process do nitrate ions get turned back into nitrogen gas in the all 7. When farmers harvest all of the crops or animals from an area, why does Explain fully.

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### 9. Nitrifying bacteria accerlogged. Explain fully why they will not have good pl

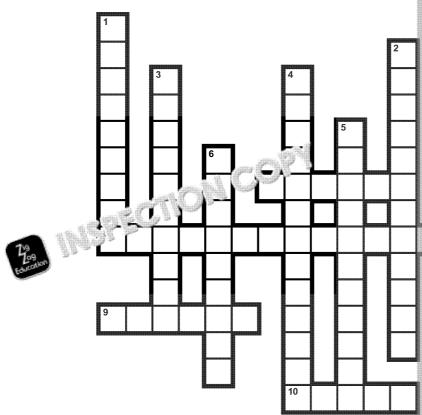
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### Quick recap

Complete the crossword below



### Across

- 7 The living elements in an ecosystem (6)
- 8 This happens as a result of leaching of nitrates into rivers (14)
- 9 The type of sampling done to avoid bias (6)
- 10 The role that an organism plays within an ecosystem (5)

### Down

- 1 The parts of plant cells that a
- 2 Measured in kJ m<sup>-2</sup> year<sup>-1</sup> (12)
- The number of organisms of o at the same time (10)
- 4 The term for the conversion or nitrate ions (13)
- **5** A relationship between two or
- **6** The term for an organism that chemosyrahesis (9)

### Extension

Draw and lakel a first or co show what happens in the carbon cycle and the

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### 14. Populations and evo

### Learning objectives

By the end of this lesson, you should be able to:

- State the biotic and abiotic factors that affect the size of a population of
- Describe and explain the relationship between predator and prey populat
- Explain the difference between interspecific competition and intraspecific
- Describe and explain the process of succession
- Calculate allele frequency using the Hardy–Weinberg equation
- Explain how changes in allele frequency may contained with reference

### Getting going

1. Match the works ചെന്ന് aefinitions.

1	nabitat
2	Community
3	Population
4	Ecosystem
5	Niche

l <sub>A</sub>	All of the organisms in an envi
	living aspects, and the interact
В	All of the organisms of one spe
P	the same time and able to rep
С	The role an organism plays in a
D	The place where an organism
Е	All of the organisms of all spec
C	the same time and able to inte

### Task 1 Population size

### Population size

The population of a species varies over time. This is due to the factors that that the species is living in. These can be biotic factors (living) or abiotic factors, most populations will fluctuate around the carrying capacity—that species that the ecosystem can sustain.

1.	Stat	te two biotic factors that can affect por ່ະ ແດ້ າ size.
	1.	
	2.	
2.	Stat	abiotic factors that can affect population size.
	1.	
	2.	

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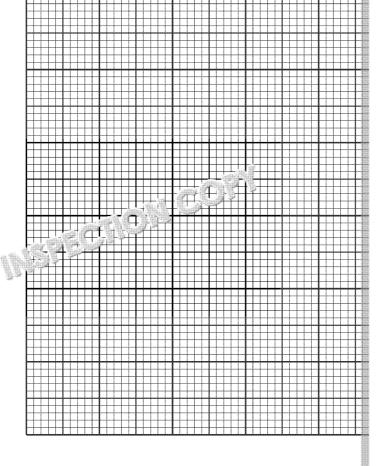
3. The following data were obtained from placing a few bacteria in a closed nutrient agar).

Time (hours)	Number of bacteria	Lo
0	40	
2	40	
4	82	
6	168	
8	336	
10	672	
12	134,	
14	٤ نام	
16	5376	
	10 752	
The state of the s	21 504	
22	43 008	
24	86 016	

b	)	Why	do	we	need	to	calcul	ate	the	log <sub>10</sub>	num	ber?	
---	---	-----	----	----	------	----	--------	-----	-----	-------------------	-----	------	--

***************************************	 **********************	******************

c) Plot the log<sub>10</sub> population numbers on the graph paper below.



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### Describe and explain the population growth over this time frame. Jilappen to the population over the nex of limiting fact In a wild population, the carrying capacity would be reached. Sugges population that would be unlikely to affect this population of bacteria

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### Task 2 Animal relationships

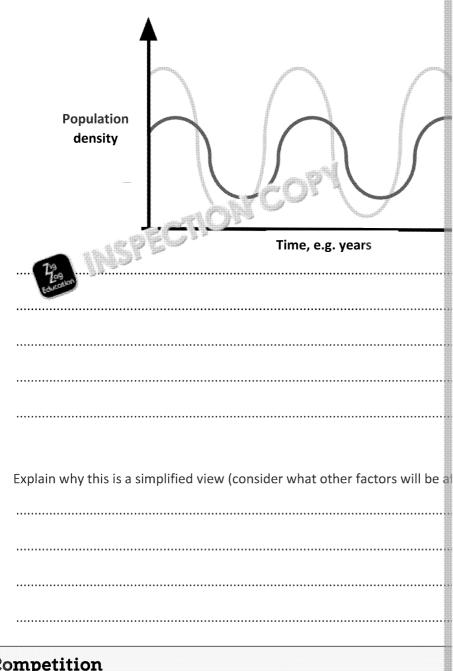
### **Predators** and prey

As we have seen already, the population of a special a less over time. One relationship between predators and prev. Prodesse eat prey, prey are eaten in each population are dependent of  $\epsilon$  to other. This would seem fairly strathe case.





Using the following graph, describe and explain the population changes shaden and explain the population changes shaden as the same of the prey numbers.

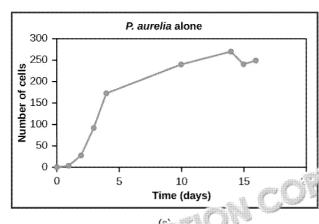


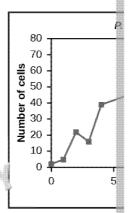
### Competition

Organisms compete for the factors within an eggs of this competition of same species, or between members of (''f ercat species.

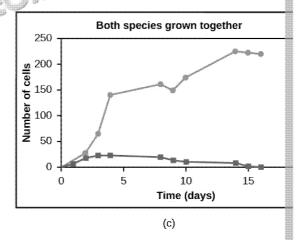
3.	Define the	fo"o w. s terms:
	40	

4. Competition can be shown by growing populations of single-celled param to show how the populations of *Paramecium aurelia* and *Paramecium cau* 









a)	Use the	data	to	describe	the	population	growth	for	the	two	specie	es:
												- 3

P. aurelia:	
P. caudatum:	
- CD	
	#

b)	ibe and explain what happens when they are grown together	(

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	c) Synoptic – State the genus of the two organisms.	
	Paramecium caudatum –	
	Paramecium aurelia –	
Ta	nsk 3 Succession	
e	Phanges in ecosystems	
is ai ol	Cosystems are dynamic – they change over time in becomes very applicable that happen in an ecosystem where stalling with nothing – compared as series of stages where organizes as a chief the area, and then are outerriving until a stable of the stands arrived at. This takes a long period observe the fire interest term. However, there are some places where we couch a chief and glaciers. This process is called succession.	ole co of
1.	Fill in the gaps to describe the process of succession.	
	Primary succession starts with; for exam	p
	This area is colonised by species such as	
	rocket. These species have which enable	t
	conditions. They change the environment	nt U
	hostile. This allows different	
	adaptations to survive, thereby increasing the	
	of This leads to an increase in biomass	aı
	Eventually, the biodiversity stabilises and a	
	Stuck? Use the words below:	
	variety lichen book block	COPYRIGHT
	species adaptations pi	PROTECTED
2.	Suggest and explain deplacions you might find in a pioneer species	
	1.	
		<b>1</b> 9
	2	Education

1.

2.

### Describe two ways in which the environment changes in the presence of a 1. Describe how secondary succession is different from primary succession. Describe using a ples, what a plagioclimax is, and how it occurs.

### Task 4 Population genetics

### Allele frequencies

As an ecosystem changes, so does the frequency of alleles for particular tradellele frequency is a measure of the number of a particular allele for a spenumber of alleles in the population for that trait. This is called population allele frequency using the Hardy—Weinberg equation. However, the allele equation to work.

The sum of all alleles for all traits within a given population is called the g change in allele frequencies within a population, this is basically evolution

You will be given the equation, but you need to ke what each of the par You also need to remember that p + ?

$$p^2 + 2pq + q^2 = 1$$



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1.		at do the following represent in terms of alleles and phenotypes?
	P <sup>2</sup> .	
	q <sup>2</sup>	
	2pq	
	р	
	q	
2.	Stat	e two reasons why the Hardy–Weinbe ွ qui on would not work fo
	1.	
	2.	
3.	The	rule 21 ladybirds within a population. 14 have red spots, the rest h
	don	ninant trait. Calculate the following:
	$q^2 =$	
	q =	
	p =	
	p <sup>2</sup> =	
	2pa	=
		at would be the estimated number of heterozygote ladybirds in the p
4.	Whit	in a population of butterflies, brown colouring is dominant over whit colouring is recessive and is determined by the allele b. A sampling
		erflies are white. Given this information, calculate the following in th  The percentage of butterflies in the population that are heterozygou
	a)	The percentage of butternies in the population that are neterozygot
	b)	The frequency of homo ( as ) is inant individuals.
	- 1	35601
	(	

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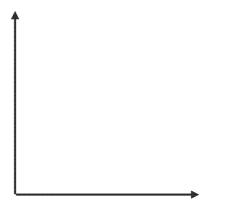
### 5. If the allele frequencies change permanently, this is evolution.

Order the statements to show the process of evolution by natural selection for you.

	This leads to an increase in the frequency of this allele in the r
	These individuals are, therefore, more likely to reproduce
	This causes variation within a population
	This leads to competition
	This means the advantageous allele is passed on to the next $\ensuremath{g}$
1	Mutations arise within a population, giving new alleles
	The environment applies selection possibles to the population
	Individuals with the rinks geous allele are more likely to sur of the fittest
	Mors 1 1 1 mans are produced than the ecosystem can sustain

### Task 5 Selection pressures

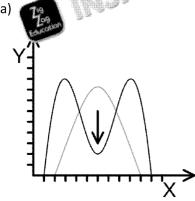
1. Sketch the shape of graph you would expect to see when looking at variat



2. State what kind of variation this is.

Describe what the causes of this variation are.

4. State which two عن المنافعة المنافعة المنافعة عند المنافعة الم



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Zig Zag Education

### Which graph – a, b or c – is more likely to lead to the development of two This process is called speciation, and can result from different isolating mechan Explain what is meant by geographical isolation. Use an example to help What kind of speciation does geographical isolation ad to? Darwin observed the Galapagos archipelago had a diffe all sale irom a common ancestor. Complete the bullet point A group of finches, all of one \_\_\_\_\_, arriv possibly as a result of a storm. Some birds landed on each island. They are now separated from each other by the \_\_\_\_\_ - they are \_\_\_\_\_\_ isolated. This means the \_\_\_\_\_ between the populations. Each separate population is subjected to different \_\_\_\_ This results in different \_\_\_\_\_\_ for some transfer The birds become so genetically different from each other th different species – they can no long referenced to produce species mutations geographically allele frequencies fertile

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9.	phys	· · · · · · · · · · · · · · · · · · ·	ead, they beco		e population remains in the same eproductively isolated. Match the
	1	Temporal		А	Genetic incompatibility that pre
	2	Behavioural		В	A change in the genitalia resulting physically able to mate with cert
	3	Mechanical		С	The timing of flowering changes they can only reproduce with ce
	4	Ecological		D	Populations are in the same are out of profilence

5

Gametic

when curtship rituals or displa

which attracts only certain other

to explain what happens during a population bottlene

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L1.	Compare and contrast the population bottleneck with the founder effect



### Quick recap

Answer the following quick-fire questions. Name the process by which an ecosystem changes over time. Name the type of speciation where there isn't a geographical barrier. Name a pioneer Define allele frequency. Define the term species. What is the term to define the role an organism plays in an ecosystem? What does q<sup>2</sup> represent in the Hardy–Weinberg equation? What is the name for competition between members of the same species 10. Define the term abiotic. 10% CO?

### Extension

- Research the difference between r-strategists and K-strategists in terms of et cafference between their population growths.
- 2. Research the difference between density-dependent factors and densityterms and find examples of each.
- Describe succession using a specific example. (You could use a sand dune



### 15. Humans and the p

### Learning objectives

By the end of this lesson, you should be able to:

- Describe the processes which transfer carbon in the carbon cycle
- Explain what has happened to the balance of these processes
- Describe the term climate change
- Use data to explain the reasons for climate change
- Describe the reasons for conservation
- Describe the role of CITES
- Explain how ecosystems can be managed in a stainable way, using example to the stainable way.

### Getting going

Comple Delow using the clues. The black boxes do not contain a legrey shall see to spell a word to do with this topic.

Process whereby light is used to create sugars			
Process that releases the energy in cells			
Involves active management of an area			
Keeping habitats as they are now			
Atom found in all organic molecules			
Burning of these releases carbon dioxide			
Term relating to money			

Word:	
vvola	Š

### The human influence

Humans have inhabited planet Earth for a very long time. However, it is history that the population has increased dramatically. This huge increase short period of time has led to a variety of problems. These include the ne number of humans that there now are, and the region of substances to Earth.

### Task 🔼

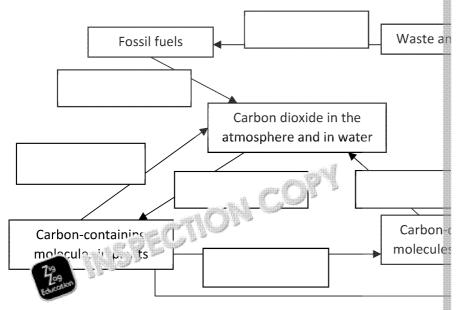
### Caston and the climate

Carbon is cycled between organisms, and between organisms and the environmentation are important processes involved in this, but the balance of these transfer increasing human population.

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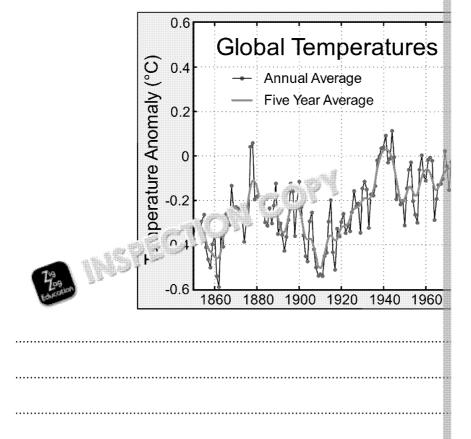


1. Complete the diagram to show the processes that happen in the carbon c around the ecosystem.



2. Carbon dioxide is considered to be a greenhouse gas – explain what this n

3. Describe the overall trend shown by the temperature graph below.



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### Suggest and explain what might happen to the distribution of plant and ar temperature continues to rise. Cows produce methane. Methane is a greenhouse gas which has about a years than carbon dioxide. There might be a straightforward way to decre you think it is? What might people say if this were suggested? In some reptiles, embryos can develop into either males or females in resi For example, one reptile lives in a habitat that is usually between 30 °C an lower than 33 °C, the embryos develop into males; above 33 °C, they will explain what the consequence of global temperature increase might be fo

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### Task 2 Why conserve?

	•			
Defi	ne conservation.			
*****			*******	
*****			•••••	
	e two reasons that have resulted fro conservation.	om human populatio	n inc	rease
1.		-084	******	******
2.			******	******
The	re are many c'in le me asons for th	e conservation of bi	odive	rsity.
Cor	th able by placing a tick in t			
	Reaso	n		
	Source of ne	w drugs		
	Every species has a	a right to exist		
	Insect species pollin	ate crop plants	***************************************	
	A source of natural preda	itors for pest species	3	
	Provide a valuable	e food source		
	Humans have a responsibility to	look after other org	anisr	ns
	Ecotourism/re	ecreation		
	e conservation method is to create a o F) to the strategies (1 to 6).	reas of land that are	prot	ected
1	Control of poachers/predators		A	Pre
2	Coppicing/mowing/grazing		В	Incr
3	Fence the area		С	Incr
4	Conservation corridors		D	Lim
5	Provide extra food		E	Pre
	Vaccinate against disease		F	Incr
6				

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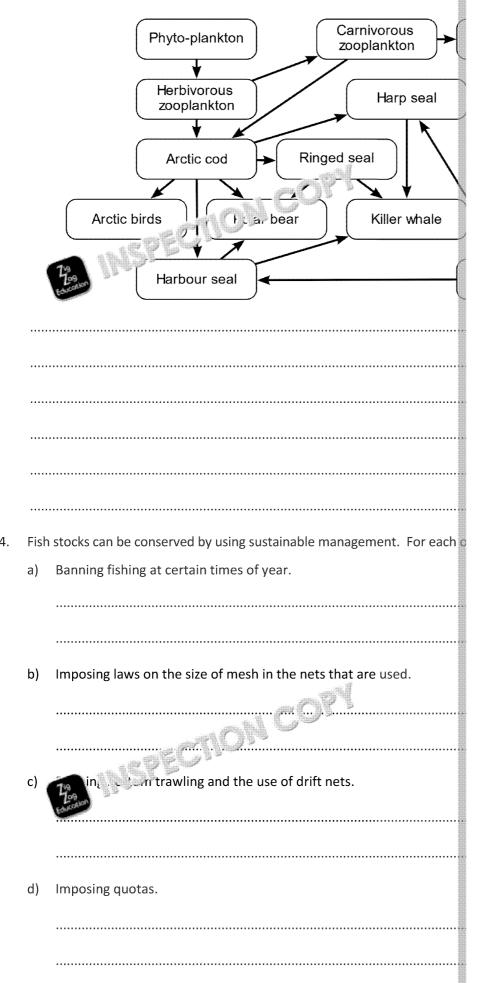


6.		cribe and explain the effect that global temperature increase might h quitoes, and explain why this is a concern for the health systems of t
	*****	
	•••••	
Ta	sk	3 Sustainability 1 COV
The natu	cont Iral e aina	inued increas 1, 2, 4, man population means that we cannot simpl
1.	Defi	ne the term sustainable, in relation to natural resources.
	*****	
	* * * * * *	
	•••••	
2.		are an important resource for a huge number of people around the ght by Canada was 500 000 tonnes in 1982, and 50 000 tonnes in 199
	a)	Calculate the percentage decrease between 1982 and 1995.
	b)	Calculate the actual yearly decrease over that time.

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3. Arctic cod are also fished. Use the following food web to describe and explose of depleting the Arctic cod stock to a very low level.



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### Discuss the possible difficulties that might result from the restrictions in Fish farms provide an alternative way of providing people with the fish the benefits and problems associated with fish farming Task 4 **Management and conflict** One way of conserving individual species is by controlling the trade of the stand for? 2. Fill in the gaps in the following paragraph to discuss the success and failur CITES is a \_\_\_\_\_\_ agreement Countries sign u COPYRIGHT \_ and, that fore many countries have not **PROTECTED** Also, countries that a in the agreement can oppose certain spec ne ເລ prevented polar bears being put on the list despite \_\_\_\_\_. This shows how there is often due to between what seems right from a \_\_\_\_\_\_ point

to local populations of \_\_\_\_\_

	CITES puts species into one of three categories, with those in a
	protected. No trade is allowed in these species, or their product
	CITES include the banning of the trade in
	increase in elephant populations in some places. Also, some
	benefited due to the ban on the trade of their fins for soup. CIT
	that the species is living in or breeding
	Stuck? Use the following terms: habitat conservation voluntarily rv climate change
bala	re argue ( ). pies around the world of successful conservation project ance nagement of the area with conflicts that may arise with the lo uires you to do a bit of research.
3.	Produce a summary to explain what projects were put in place to try to description of Nepal and the Maasai Mara in Kenya. For each area try to describe negative consequences of each of the projects. Include information

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### 4. In the national parks of the UK, conservation is difficult due to the land be of visitors for recreational purposes. For each of the management strateg benefit is.

Management strategy	
Footpaths are well maintained	
Drainage ditches are dug across footpaths	
Financial incentives for landowners to plant a greater variety of trees	
Farmers are to comaintain hay meadows are two	
Blocking drainage ditches on open land (ones made by farmers) with hay bales	
Removal of invasive species such as rhododendron	
Reduction in grazing by sheep	
Seasonal restrictions on walkers	

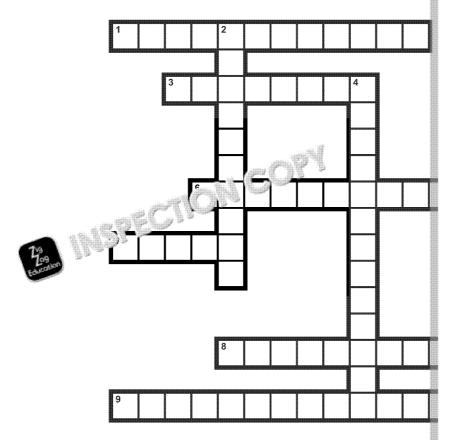
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### Quick recap

Complete the crossword below.



### Across

- 1 Involves active management of an ecosystem (12)
- 3 Relating to money (8)
- 6 The effect caused by gases such as carbon dioxide (10)
- 7 A voluntary agreement on trade in wild animals and plants (5)
- 8 The use of resources which gives a decent standard of living now without compromising future generations (11)
- **9** Effects produced by people (13)

### Extension

Produce a poster to show the challenges being used to manage the second cts.



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### Answers

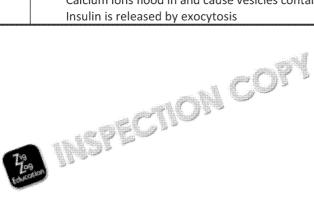
### 1. Homeostasis

Task		Answers				
number	1					
Getting	1.	1C, 2A, 3D, 4E, 5B, 6F Polymer of alpha glucose monomers joined by glycosidic bonds f				
going	2.	Contains 1 : 4 and 1 : 6 glycosidic bonds – the 1 : 6 give the molec				
	1.	Maintenance of a constant internal environment, despite changes i				
	2.	Endocrine gland releases hormones into the blood; exocrine glan				
	3.	Synoptic: Glycoproteins/glycolipids				
	4.	Synoptic: Polymer of amino acids is a sticular order joined by p				
		structure – a length of privile, id , mis folds into the secondary				
		This folds into the state of Scructure, held in place by H bonds, dis				
1		hydroph integrations between R groups. This gives the 3D st				
		have out of lipid				
	200	Increase/decrease in factor → Receptors detect the increase/dec				
<b>V</b>		the coordination centre / communications centre $ ightarrow$ A message i				
		brings about a response → The factor returns to the norm				
	7.	Positive feedback results in an exacerbation of the change. An increase leads to further decrease. Examples include shildbirth an				
	1.	decrease leads to further decrease. Examples include childbirth an 1. Hormone binds to a complementary receptor in the plasma				
	<b>.</b>	<ol> <li>This initiates a change in the G protein complex</li> </ol>				
		3. The G protein can now activate adenylyl cyclase				
		4. Adenylyl cyclase catalyses the formation of cAMP from ATP				
	2.	5. cAMP is the second messenger and activates other enzyme				
	2.	2 In the cytoplasm the hormone binds to a receptor				
2		5 Genes are turned on, and proteins are made through tr				
		1 The hormone passes through the cell membrane				
		4 The complex now acts as a transcription factor				
		4 The complex now acts as a transcription factor				
	3.	4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro				
		4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.				
	3.	4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble. Alpha and beta cells are specialised cells				
		4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue – a group of specialised cells w				
		4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue – a group of specialised cells w particular function				
		4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue – a group of specialised cells w particular function				
		4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue – a group of specialised cells w particular function The pancreas is an organ – several different tissues (islets of Lang working towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, secon				
	2.	4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue – a group of specialised cells w particular function The pancreas is an organ – several different tissues (islets of Lang working towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, secon membrane, glycogen, respiration, falling				
3	1.	4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue – a group of specialised cells w particular function The pancreas is an organ – several different tissues (islets of Langworking towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, secon membrane, glycogen, respiration, falling This results in more glycogen bias con erted into glucose,				
3	2.	4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue – a group of specialised cells w particular function The pancreas is an organ – several different tissues (islets of Langworking towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, secon membrane, glycogen, respiration, falling This results in more glycogen being cell erted into glucose, less glucose being used in respiration,				
3	2.	4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue – a group of specialised cells w particular function The pancreas is an organ – several different tissues (islets of Langerhing towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, secon membrane, glycogen, respiration, falling This results in more glycogen being content of the properties of the glucose, less glucose being used in specialised cells This received graph of the properties of the				
3	2.	4 The complex now acts as a transcription factor 3 The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue — a group of specialised cells w particular function The pancreas is an organ — several different tissues (islets of Langerhing towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, secon membrane, glycogen, respiration, falling This results in more glycogen bring cc erted into glucose, less glucose being used in specific confidence.  This recomplex now acts as a transcription factor.  This results in force is a tissue — a group of specialised cells w particular function.  This results in more glycogen bring cc erted into glucose, less glucose being used in specific confidence.  This recomplex now acts as a transcription factor.  This results in factor is a tissue — a group of specialised cells w particular function.  This results in more glycogen bring cc erted into glucose, less glucose being used in specific confidence.  This results in more glycogen bring cc erted into glucose, less glucose being used in specific confidence.  This results in more glycogen bring cc erted into glycogen through the specific confidence in the blood glucose into glycogen through the specific confidence in the blood glycogen through the specific confidence in the specific confidence in the blood glycogen through the specific confidence in the specific confidence in the specifi				
3	1. 2. 3.	The complex now acts as a transcription factor  The hormone-receptor complex can now pass into the  Steroid hormones are lipid based and, therefore, can diffuse through the second pass they are lipid soluble.  Alpha and beta cells are specialised cells  The islet of Langerhans is a tissue – a group of specialised cells we particular function  The pancreas is an organ – several different tissues (islets of Langworking towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, second membrane, glycogen, respiration, falling  This results in more glycogen being colored into glucose, less glucose being used in the specific on, glucose being used in the specific on, glucose being used in the specific on, glucose being colored into a lipid on the blood, so the blood glucose necessary in the specific of glycogen to release glucose				
3	1. 2. 3.	The complex now acts as a transcription factor  The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse through the second hormones are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue — a group of specialised cells we particular function The pancreas is an organ — several different tissues (islets of Langerhing towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, second membrane, glycogen, respiration, falling This results in more glycogen being confident into glucose, less glucose being used in respiration, glucose being used in respiration, falling confidence in the second glucose being and proposed into the blood, so the blood glucose in the second glucose molecules into glycogen through the second glucose of the second glucose of glycogen to release glucose of gluconeogenesis — creation of glucose from non-carbohydrate second gluconeogenesis — creation glucose from non-carbohydrate second gluc				
3	1. 2. 3.	The complex now acts as a transcription factor  The hormone-receptor complex can now pass into the  Steroid hormones are lipid based and, therefore, can diffuse through the second pass they are lipid soluble.  Alpha and beta cells are specialised cells  The islet of Langerhans is a tissue — a group of specialised cells we particular function  The pancreas is an organ — several different tissues (islets of Langerhans towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, second membrane, glycogen, respiration, falling  This results in more glycogen being considered into glucose, less glucose being used in respiration, glucose being used in respiration acids and glycerol.  This received glucose diffusing into the blood, so the blood glucose into glycogen lands and glycogen through the second passed in the place of the p				
3	1. 2. 3.	The complex now acts as a transcription factor  The hormone-receptor complex can now pass into the  Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue – a group of specialised cells we particular function The pancreas is an organ – several different tissues (islets of Lang working towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, second membrane, glycogen, respiration, falling This results in more glycogen being cone and glycose, less glucose being used in specific cone and glycose, less glucose being used in specific cone and glycogen through the second process of the process of the blood glucose.  This received in the process of glycogen to release glucose  Gluconeogenesis – creation of glucose from non-carbohydrate second glucose is taken up by cells to be used in respiration  Type 1 diabetes is as a result of the pancreas not producing insuling the pancreas in the pancreas in the producing insuling the pancreas in the				
3	1. 2. 3.	The complex now acts as a transcription factor  The hormone-receptor complex can now pass into the  Steroid hormones are lipid based and, therefore, can diffuse through the second pass they are lipid soluble.  Alpha and beta cells are specialised cells  The islet of Langerhans is a tissue — a group of specialised cells we particular function  The pancreas is an organ — several different tissues (islets of Langer working towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, second membrane, glycogen, respiration, falling  This results in more glycogen being confermed into glucose, less glucose being used in respiration, glucose being used in respiration, glucose being used in respiration acids and glycerol.  This recomplex is — converting glucose molecules into glycogen through the use — converting glucose from non-carbohydrate second into glucose is taken up by cells to be used in respiration.  Type 1 diabetes is as a result of the pancreas not producing insular result of overstimulation of the receptors for insulin — they have				
74.	1. 2. 3. 4.	The complex now acts as a transcription factor  The hormone-receptor complex can now pass into the Steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue — a group of specialised cells we particular function The pancreas is an organ — several different tissues (islets of Lang working towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, secon membrane, glycogen, respiration, falling This results in more glycogen being confermed in the special second glucose, less glucose being used in the special second glycogen being to be a special second glycogen to precise a converting glucose molecules into glycogen through the second glycogen second glycogen second glycogen to release glucose  Gluconeogenesis — creation of glycogen to release glycose Gluconeogenesis — creation of glycogen to release glycose Gluconeogenesis — creation of glycogen to release glycose Glyconeogenesis — creation of glycose from non-carbohydrate second glycose is taken up by cells to be used in respiration  Type 1 diabetes is as a result of the pancreas not producing insuline result of overstimulation of the receptors for insulin — they have respond to the insulin. Sometimes the pancreas also does not present the pan				
3	1. 2. 3.	The complex now acts as a transcription factor  The hormone-receptor complex can now pass into the steroid hormones are lipid based and, therefore, can diffuse thro This is because they are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue — a group of specialised cells we particular function The pancreas is an organ — several different tissues (islets of Lang working towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, second membrane, glycogen, respiration, falling This results in more glycogen because of the organ glucose being used in spiration, glucose, less glucose being used in spiration, glucose being a rolumino acids and glycerol.  This results in more glycogen because of the blood, so the blood glucose in the sist — converting glucose molecules into glycogen through yoogenolysis — hydrolysis of glycogen to release glucose  Gluconeogenesis — creation of glucose from non-carbohydrate so Eating and drinking increases the blood sugar level; exercise will glucose is taken up by cells to be used in respiration  Type 1 diabetes is as a result of the pancreas not producing insulines ultimated the insulin. Sometimes the pancreas also does not profit t				
The state	1. 2. 3. 4.	The complex now acts as a transcription factor  The hormone-receptor complex can now pass into the steroid hormones are lipid based and, therefore, can diffuse through the steroid hormones are lipid soluble.  Alpha and beta cells are specialised cells The islet of Langerhans is a tissue – a group of specialised cells we particular function The pancreas is an organ – several different tissues (islets of Langworking towards multiple functions of the organ β cells, Langerhans, insulin, blood, receptors, hepatocytes, second membrane, glycogen, respiration, falling This results in more glycogen being confirmed in the specific confirmed in				

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Task number		Answers
	3.	a) The person has eaten a meal containing carbohydrate
		<ul> <li>Answers will vary – the starting level should be higher, the in longer to return to the original level</li> </ul>
		<ul> <li>Just after one hour, as the increase in blood glucose will resu time afterwards</li> </ul>
4 cont.		d) Units for the blood glucose concentration. Also allow a title
	4.	Pig insulin – this is not exactly the same as human insulin, and peo
		Genetically modified bacteria to produce human insulin – most
		It's exactly the same as human insulin, so the tolerance won't dev
		rejection due to an immune response.
		The future – the use of stem cells to replace the pancreatic tissue
	a)	FALSE – hormones are produce in en crine glands
	b)	TRUE
	c)	TRUE
	d)	FALSE in hormones bind to receptors on cell surface members.
Quic		t real normanes bind to receptors in the cytoplasm
reca	)	ALSE – <u>negative</u> feedback results in a reversal of a change OR pos
recap		increase/continuation of a change
	f)	TRUE
	g)	FALSE – <u>cAMP</u> is a second messenger
	h)	TRUE
	i)	FALSE – <u>steroid</u> hormones can pass through the phospholipid bila
	1.	Upon insulin binding to the receptor, tyrosine kinase is activated.
		This causes a phosphorylation cascade where many enzymes are
		Some of these enzymes cause vesicles containing glucose channel
		plasma membrane.
		Others catalyse the conversion of glucose to glycogen.
	2.	Decrease in temperature leads to decrease in enzyme activity.
		This could lead to a decrease in respiration as it is controlled by er
		This leads to less heat being produced.
Extension		This then decreases the temperature further.
	,	This leads to even lower enzyme activity.
	3.	Blood glucose levels increase Glucose enters B cells
		Glucose is phosphorylated and ATP is produced ATP closes the potassium ion channels
		An increase in potassium ions inside the cell increases the charge
		This change in potential difference opens calcium ion channels
		Calcium ions flood in and cause vesicles containing insulin to move
		Insulin is released by executoris



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### 2. Thermoregulation

2. Thermore	gulation
Task number	Answers
	1. <b>Homeostasis</b> : the maintenance of stable internal conditions despi
	internal factors
	Negative feedback: the body detects a change from optimum and
	order to reverse the change
	2. nebejite 4
	2. activity (%) 100-
Getting	100-
going	
19	4t) temperature (C)
	As temperature increases, rate of reaction also increases. This is
	leads to an increase in kinetic energy of molecules. This means m
	be formed per unit time, hence increasing the rate.
	2. As the temperature increase above 40 °C, the rate of reaction will
	because the further increase in kinetic energy causes hydrogen be
	vibrate and break. The enzyme will lose its 3D shape – it is denati
	complementary to the substrate, so ESC cannot form.
	3. Uses external sources of heat to maintain body temperature
	4. 1C, 2A, 3B
1	5. a) Lizards change shape to increase or decrease the surface are decrease the amount of heat absorbed
	b) Basking in sunlight absorbs heat directly from the Sun
	c) Moving to a higher place means the insect is further away for
	6. This decreases the freezing point of water. If water freezes inside
	damaged. These chemicals resist that.
	7. Because they use a greater proportion of the energy they get from
	proteins. This is because they do not need to use the energy to n
	a more efficient transfer if we were to eat them.
	8. It hasn't absorbed enough heat to become active yet, so the flight
	Later in the day it will be warmer and the bee will have absorbed  1. An organism that uses internal sources of heat to maintain body to
	1. An organism that uses internal sources of heat to maintain body t 2.
	Optimum temperature
	Temperature increases Tem
	- 18 C 18 S
	Arterioles le
	1
2	illaries dilate – vaso <b>dilation const</b> rاانها
	<b>●</b>
	More blood flows in the capillaries Less bloo
	near the skin surface near
	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
	More heat is lost through radiation Less heat
	Optimum temperature
	<u> </u>

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Task			Answers		
number			Allsweis		
	3.	Sweat contains water. Heat from in	nside the body is used to raise		
		evaporates off the surface of the sk	-		
		down. Water has a high latent hea			
		in order for it to change state.	·		
	4.	Hypothalamus, peripheral, thermo	regulatory, autonomic, effecto		
	5.	,, , , , ,			
		Factor	Endotherm		
2 cont.		Volume of food required	More		
£ COIIC.		Proportion of energy used for	WOLC		
		growth	Less		
		Habitat range	/k st places on Earth		
		Survival chances without for a	Lower		
			Lower		
		Activity leve in the second	Not as affected		
		tringetic us	11:		
	<u> </u>	è è cor overheating	Higher		
<b>(19</b> )	1.	, or reduce the surface-area-to			
	<b>6</b>	b) To reduce cooling – to act as t			
		c) To reduce the surface area av			
	2.	1 – warm blood flows into the leg in	n an artery which is deep insid		
		2 – heat is transferred to the vein			
		3 – the vein returns blood to the bo	•		
3		The blood reaching the foot is colde			
	3.	Venous blood is cooled somehow -			
		allows much heat to be radiated to the air			
		The cooled venous blood then runs close to the arteriole blood			
		the venous blood			
		The arteriole blood is therefore cooled before it reaches the orga			
		The warmed venous blood returns	<del></del>		
	1.	(thermoreceptors in the ) Hypothal	amus		
	2.	Ectotherm			
Quick	3.	Behavioural			
recap	4.	Radiation			
	5.	Receptors			
	6.	Countercurrent			
	Stuc	lent poster should include:			
	•	Title – short and draws attention			
	•	Definitions – succinct			
	•	Binomial names of organisms used	as examples		
	•	Layout – clear and concise; use of b	ullet points where appropriat		
	•	Use of graphics, and sources refere	nced		
Evancion	<u>Gen</u>	eral ideas on thermoregulation could	d ing: <u>e</u> :		
Extension	•	Methods to decrease heat los			
	•	Methods to increase			
	•	Methods to in a sharloss – vas			
	•		Methods to have across – vasodilation, sweating  Methods to have across – vasodilation, sweating		
			1. erences between ectotherms and endotherms in terms of		
<b>(1</b> %)		to the contract of the contrac			
	a i	particular organism is chosen, the po	ster should explain any specifi		
***************************************	1	erms of thermoregulation.	,,,,,		
		5			

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### 3. Excretion - the kidneys and the liver

ವ. EXCretion	- tn	e kidneys and thi	e liver
Task number			Answers
	1.		
		Excretion	The removal of metabolic waste from the body
		Secretion	The removal of a substance from a cell
		Nephron	The kidney is made up of these tiny tubules
		Liver	Large organ involved in making urea, among m
Getting		Amino acid	A monomer of a protein. It contains an amino
going		Allillo aciu	group at the other end.
		Epithelial cell	A cell lining a tube
		Microvilli	Folds of the plasma mgr brane to increase sur
Fig.	1.	Reducing sugar: A	et reagen*. / IIIa /r rule colour indicates presende and heat to 80 °C for 3 me and heat to 80 °C for 8 me and heat to 80 °C for
	<ol> <li>3.</li> </ol>	Protein in the diet bloodstream in the To remove an ami	ne group
1	4.	Bowi	man's capsule – PCT – selective transpole
Tgo.		Aff went ar  Loop of Hedescendin  water read	teriole  Loop of Henle ascending limb enle glimb –
	5.	<ol> <li>Bowman's ca</li> <li>Glomerulus</li> <li>Convoluted t</li> </ol>	

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Task number	Answers
	6. Synoptic: (75 000 / 200) = 375
	7. The lining of the proximal convoluted tubule might look furry – t
1 cont.	The distal convoluted tubule does not have this.
	8. The kidney is three-dimensional. When making the slides, some
	angles to others, making them appear different shapes. In reality be shown on a two-dimensional slide.
	Water, ions, urea, glucose, amino acids
	2. Blood cells, proteins
	3.
	Start of the PTC
	13 13
	H G H
	B
	Bow
W	
2	
	Efferent arteriole Afferent arte
	7 Interest and
	4. Afferent arteriole is wider than the efferent arteriole. This provides
	substances out of the blood in the glomerulus.
	5. Endothelium of the capillary – many pores to allow substances the
	Basement membrane – allows small substances to pass through t
	molecular sieve.
	Lining of the Bowman's capsule – composed of specialised cells c
	processes of these cells allow substances to pass between the ce
	<ul> <li>6. 125 × 60 × 24 = 180 000 cm<sup>3</sup></li> <li>7. Capillaries usually connect arterioles to venules. Glomerular capi</li> </ul>
	Actively, basal, concentration, diffuse, some insport, glucose / am
	facilitated diffusion, water potrail (, c) josis, urea
	2. a) Units in the heading
	All data to an enumber of decimal places,
	air in ach column
40	ey are too large to fit through the basement membrane  They are all reabsorbed back into the blood in the PCT
	d) Water is reabsorbed back into the blood, so the concentration
3	3.
, ,	Process
	Company displayed and although a contract of the contract of t
	Some sodium and chloride ions diffuse out of the hairpin into Sodium and chloride ions are actively transported out of the t
	ascending limb.
	Water moves out of the descending limb by osmosis.
	C 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

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Sodium and chloride ions diffuse into the descending limb.

Task number			Answers		
	4.	Counte	rcurrent mechanism		
3 cont.	5.	The longer the loop, the lower the water potential can reach. T concentrated with ions.			
	1.	When the body detects a change in conditions and responds to re			
		optimum levels			
	2.	2.			
		2	A signal is sent to the posterior pituitary to release more		
		8	Water potential of the blood returns to normal		
4		5	A cascade of reactions occurs resulting in vesicles contain fuse with the cell membrane		
		7	More water is reabsorbed by and sis; smaller volume of		
		3	ADH binds to recente so the cells lining the collecting		
		6	This increas so the collecting duct to		
		4	c^n r is 'c id in the cell		
	1 Leceptors in the hypothalamus detect a decrease				
740	<b>B</b> 3.	C).AL	H is released. This means less water is reabsorbed from the		
of less concentrated urine being produced.					
	a)	TRUE			
Quick recap	b)	FALSE -	- all amino acids contain C, H, O and N. Only some contain		
	c)	TRUE			
	d)	FALSE – the capillaries in the glomerulus are lined with endothelia			
	e)	TRUE			
	f)	FALSE – selective reabsorption results in <u>some</u> of the glucose bein			
	g)	FALSE – cells of the PCT are lined with <u>microvilli</u> to increase the su			
	h)	TRUE			
	i)	FALSE – the longer the loop of Henle, the <u>lower</u> the water potentia			
	j)				
	k)		hould be easy to read and should not contain too reuch in		
Extension	The poster should be easy to read and should not contain too much inf Pictures should be included to help explain the points.				
EXTENSION	References should be stated.				
	References Should be Stated.				







### 4. The nervous system and control of heart rate

Task					
number Answers					
<ol> <li>Stimulus, receptor, sensory neurone, relay neurone (CNS), m</li> <li>2.</li> </ol>	otor				
Channel protein  Protein embedded in the phospholip polar substances down a gradient the	3333				
Ion Charged particle					
Active transport Use of ATP to move a molecule again	nst th				
The passive net movement of molec					
Getting going Diffusion concentration to an area of lower concentration to a lower conc	oncen				
Facilitated diffusion  The net move ant of particles down than a least proteins					
Frequency in a number of times something occ	HIPC VA				
When a vesicle inside a cell fuses wit					
the contents of the vesicle out of the					
Adenosine triphosphate. Used to tran	sier				
Edecari.					
Dendrite	,				
Axon Terr	minal				
Node of Ranvier Cell body					
80 2					
Axon Schwani	n cell				
Myelin sheath					
	Nucleus				
	<b>Dendrite</b> – many of these to connect with many other neurones				
	Nucleus – contains DNA, which has the instructions to make the p				
	Cell body – cytoplasm, contains many mitochondria and ribosome				
	Axon – long to enable faster transmission of the impulse				
	Myelin sheath – provides electrical insulation				
	Node of Ranvier – unmyelinated section of axon where ion trans				
cell can occur					
Schwann cell – makes up the myelin sheath					
Axon terminal – allows connections to muscles/glands	rios = 3.1				
	2. Cell body is not at the end. It has a dendron to transmit information from recent to the CNS				
neurones transmit information from receptors to the CNS.					
<ul><li>3. To transduce energy from one form into another (electrical energ</li><li>4. Any three from:</li></ul>					
·					
	Light – light-sensitive cell , he i ina of the eye				
	• Temperature – the skin and the hy				
• Taste – i.e. 1 ceptors in the tongue					
Ship in mical receptors in the nasal cavity					
und – receptors in the cochlea that detect air vibrations					
	Pressure – pressure receptors in the skin, the Pacinian corpu				
A bundle of neurones					
6. Somatic is voluntary (requires thought), whereas the autono	mic is				
	thought)				
7. Both – responds to stimuli, involves communication between	າ cells				
	involve negative feedback				
	Nervous – mostly electrical signals along neurones, faster acting, s				
Endocrine – chemical signals in the blood, slower acting, long	ger d≀				
8. 1B, 2D, 3A, 4C					

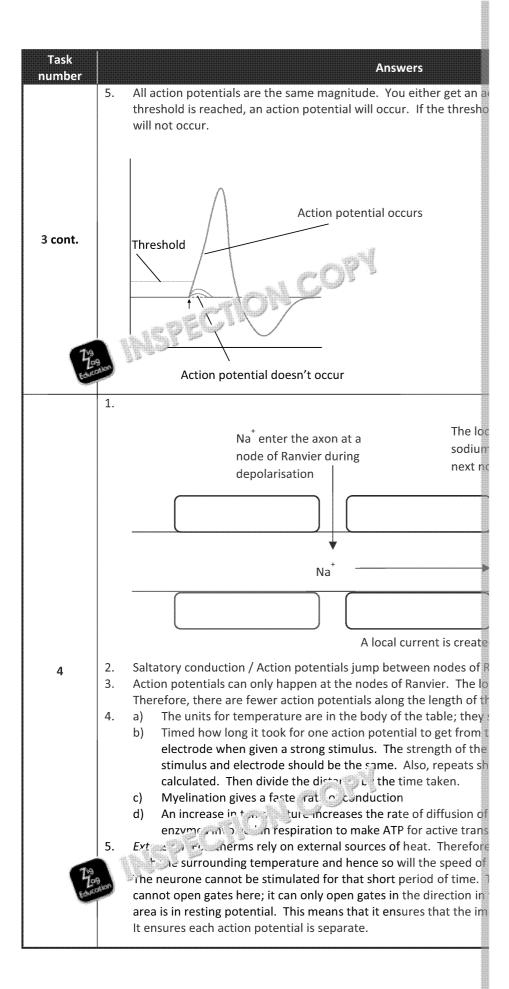
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#### Task **Answers** number 1. Sodium ions and potassium ions 2. ATP, sodium, potassium, concentration gradients, closed, open, potential difference 2 To provide ATP through aerobic respiration in order to do active to 4. (Also many in the presynaptic bulb for movement of vesicles and neurotransmitter components.) 1. depolarisation repolarisation -70mV resting potential hyperpolarisation Time 2. 3 11 The inside of the axon becomes hyperpolarised, leading to Some sodium ions diffuse into the cell. The membrane is at resting potential. Sodium ions diffuse into the cell. 12 The membrane then returns to resting potential. The inside of the cell starts to become more positive comp If enough sodium ions enter, the threshold will be exceed be depolarised. Some sodium ion channels open. 10 This is repolarisation. This causes more sodium ion channels to open (voltage gat When the charge reaches about +35 mV, the voltage-gate and voltage-gated potassium ion channels will open. Potassium will diffuse out of the sail the inside will become the outside. As sodium ions enter the way, the yuncrease the charge inside the channels (voltage length and sendium ions can diffuse in a This or sodium ion channels. hannel that opens or closes at a particular change in charge

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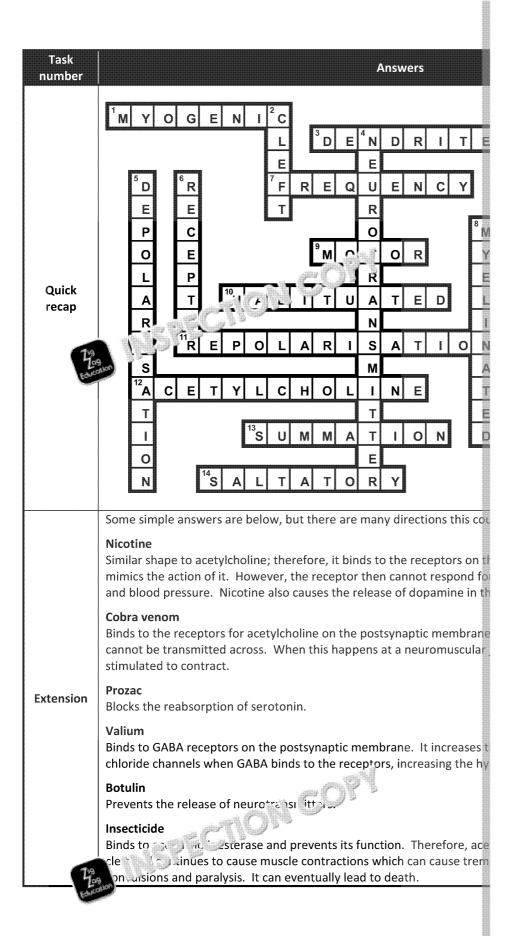




Task number		Answers
	1.	1. An action potential arrives at the presynaptic bulb
		2. The change in charge causes voltage-gated calcium ion chann
		3. The rise in calcium ions causes vesicles containing acetylcho
		presynaptic membrane
		4. The acetylcholine diffuses across the synaptic cleft
		5. The acetylcholine binds with a receptor on the postsynaptic
		6. The receptor is associated with a sodium ion channel, which
		into the axon
5		7. The charge increases inside the postsynaptic neurone (an EF
		threshold will be reached and an action potential will be ger  8. The acetylcholine is broken down ' enzyme (acetylcholi
		8. The acetylcholine is broken down ' enzyme (acetylcholi actively transported into ' re , tapac bulb.
	2.	To provide ATP for move and fesicles and active transport of
	۷.	active transport of the session active transport of
	3.	Lipid s s - 13 make the membranes around the vesicles
	4.	is make the membranes around the vesicles
19		eurotransmitter are only on the postsynaptic membrane
		1F, 2D, 3A, 4I, 5C, 6G, 7H, 8B, 9E
	1.	a) FALSE – there is a patch of tissue in the <u>right</u> atrium called the
		b) FALSE – the SAN generates its own impulse
		c) TRUE
		d) FALSE – the contraction forces blood from the atria into the
		e) TRUE
		f) FALSE – only the <u>AVN</u> can transmit the electrical impulse
		g) TRUE
		h) TRUE
		i) FALSE – this causes the walls of the ventricles to contract from
		j) TRUE
	2.	a)  Increase in carbon dioxide results in a dec
		71:: 1 × × 11 1 × × × × × × × × × × × × ×
		This is detected by chemoreceptors in the walls of the
	l ,	
		An impulse is sent from the chemoreceptor to the cardiovascula
_		
6	Г	An impulse is sent along sympathetic fibres to the SAN to inc
		An impulse is sent along sympathetic fibres to the SAN to inc
		b) Blood pressure increases
		Detected by pressure records in the walls of the a
		A is the inventor the condition of the
		1 impulse is sent to the cardiovascular centre in
4		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
		An impulse is sent along parasympathetic fibres to the SAN to
~		
	3.	Extension: Adrenaline is released from the adrenal glands in response
		flight response. The effects include increased heart rate, increase
		contraction of piloerector muscles, vasoconstriction of arterioles
		metabolic rate, vasodilation of arterioles leading to muscles, rele

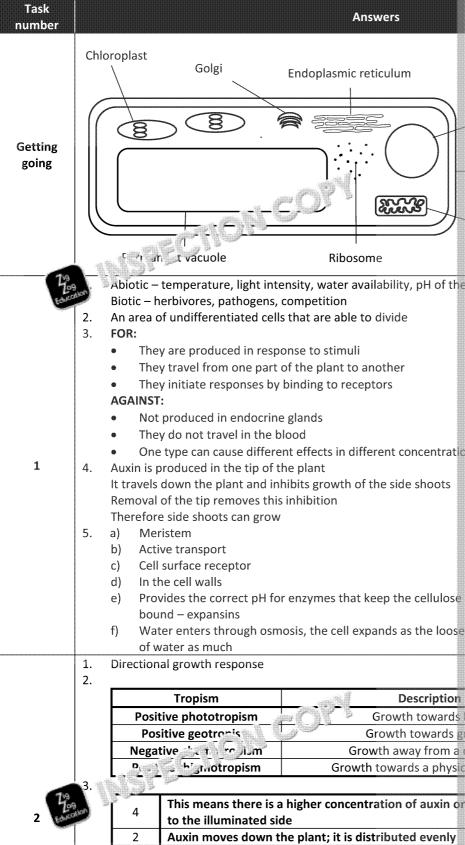
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#### 5. Plant hormones



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4	This means there is a higher concentration of auxin or to the illuminated side
2	Auxin moves down the plant; it is distributed evenly
6	This causes the shaded side to grow longer than the u shoot to bend towards the light
5	Therefore, the cells on the shaded side are stimulated cells on the illuminated side
1	Auxin is produced in the growing tip of the plant
3	When light is shone from only one side, the auxin motowards the shaded side

#### Task Answers number The cells on the left need to be longer than the cells on the right Auxin is produced in the cells of the root tip Auxin travels back down the root Auxin moves to the lower side is to ; svity More auxin on the lower 'e true upper side The auxin inhibition in the root Cells on the upper s Te. er side gets longer than the upper side The root bends downwards 2 cont. 6. Result **Treatment** Shoot does not bend Tip removed / no response Tip present but covered with Shoot does not bend a cap that is opaque / no response Tip removed, then replaced but with a gelatine block in Shoot bends towards the light between A thin glass plate is inserted Shoot does not bend; the amount of IAA on each side to separate two sides of \_ ု ု e plate is equal a shoot The auxin would be able to tree in one side to the other and This would allow a ship too respond in a normal way to light. Serial dill and hst The of the stock solution, add 9 cm<sup>3</sup> of distilled water. The Take 1 cm $^3$ of the 1 g cm $^{-3}$ solution, add 9 cm $^3$ of distilled water. T solution $(1 \times 10^{-1})$ . Take 1 cm<sup>3</sup> of the 0.1 g cm<sup>-3</sup> solution, add 9 cm<sup>3</sup> of distilled water solution $(1 \times 10^{-2})$ . 3 Continue in this way until you have all of the solutions 2. Five seedlings with their tip not removed, no auxin added. This w results to what happens in a normal situation. The tip is a source of auxin. By removing the tip, they remove the 3.

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that any difference they see is only due to the applied auxin.

To enable a mean to be calculated. This will allow reliability to be

Task									
number						Answ	ers		
	5.	Any two from:							
		Species of seedling –		•	•			7	
		Age of seedling – you	ınger see	edlings	may gr	ow fast	er/slow	er tha	
		Temperature – an inc	crease w	ill incre	ase kin	etic ene	ergy and	d, ther	
		Light intensity – high	er light i	ntensity	/ mean	s highe	r rate of	f phote	
		Aseptic growing cond	ditions –	to avoi	d comp	etition			
	6.	See table							
		Concentration of		lorcont	ago cti	mulatio	· n		
		auxin (ppm)	1	2	3	4	5	ľ	
		1 × 10 <sup>-5</sup>	0	2	n	0	1		
		$1 \times 10^{-4}$	12	15	L	17	15		
		1 × 10	12	<u> </u>	↓ _ <u>°</u> - 66	44	40		
3 cont.		$1 \times 10$ $1 \times 10^{-2}$	-	-			22		
		1 × 10	1 5	26	28	15			
		L	2	0	1	0	0		
4	7.	, Lirart							
		Concentration of aux	in on the	e x-axis,	with u	ınits – p	pm		
		Mean percentage sti							
		Linear scale y-axis							
		At least 50 % of the p	oaper use	ed for p	lotting				
		Mean plotted to with	nin half a	small s	quare				
		Standard deviation s	hown as	error b	ars – oi	ne sd al	oove the	e mea	
		straight line							
	8. The standard deviations do not overlap. This means it is li					ns it is li	kely th		
		between the means.							
	a)	TRUE							
	b) FALSE – auxin is produced in the tips of the shoots and roots								
	c) FALSE – auxin <u>inhibits</u> elongation of cells in the root d) FALSE – when a plant grows towards a light source it is positively								
Quick	d)	FALSE – when a plan	t grows t	owards	a light	source	it is pos	sitively	
recap	e)								
	f) FALSE – auxin inhibits growth of side shoots								
	g)	FALSE – <u>meristem ce</u>	<u>lls</u> can di	vide					
	1	A DIN protoin is a tra	ncmamh	rano nr	atain f	ound o	n nlacm	3 man	
	1.	A PIN protein is a tra the flow of auxin out						- 30	
	2.	the new or auxili out	. OI LIIC LI	-113, UIC	I COY III	muchil	יים נווכ נ	אטו וטכוג	
	۰.	Hormone Fu	unctions						
				tconor	canca				
			elays frui ongates		cence				
		1	ongates		talle				
			_			tion			
		I (-innaralling	Stimulates seed germination Stimulates growth between nodes						
			imulates		100000000000000000000000000000000000000	88	103		
				100000000000000000000000000000000000000	2006-2005				
Extension			Stimula es tegricongation (Similares bolting						
			romotes			nwth			
			elays lea		_	7 VV (1 I			
		- v/* knin i	romotes			t grow+	h in ticc	ile ciile	
			eaf abscis	-	C 311001	, BIOWI		ac cuit	
4			romotes		ening				
***************************************		l p	romotes	-	_				
		I thene	romotes		•	in cuc	umhers		
			romotes						
			<b>3</b>	hibits se				c piant:	
		I Abscisic acid	auses sto	-		: 1			
			uuses StU	unatal (	iosuit			•••••	



#### 6. Muscle contraction

6. Muscle cor	itraction		
Task number	1.	Answers	
	Level of protein	Description / labelled diagram	
	structure Primary	Amino acids in a chain	Pep
Getting	Secondary	The chain of amino acids is folded, or arranged in a helix/pleated sheet.	
going	Tertiary	The structure is folded into its 3D sha	pe Hydr Disu Hydr
	<ol> <li>More than one together ag</li> </ol>	no' r ep ່ ຍ hain joined together. For ge. ເວລ ເກree	example,
The state of the s	Cardiac m	uscle	ched to bo
Edicon	Skeletal m	Cont	tractions ca ventricles
	Smooth m	uscle	er involunt nervous s
	b) Cytoplasn c) Endoplasn 3. a) Thin filam b) Thick filar 4.		A ban
1	5. Anywhere fron	Sarcomere n Z line to Z line (the darker line)	
75 stanton			

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Task number	Answ	vers		
1 cont.	6.			
79 686	<ol> <li>A – motor neurone, B – secretory vesicle, C – reception 18, 28, 3A, 5B, 6A, 7B</li> <li>Both:         <ul> <li>Have neurotransmitters 'endit with across the cleft Use entities to high across the neurotransmitter</li> <li>Year olyse the neurotransmitter</li></ul></li></ol>	smitters		
2	Directices.			
- Company	NMJ			
	Always acetylcholine	Many differen		
	Neurone to muscle	Neurone to		
	Always excitatory	Can be excit		
	Does not initiate an action potential in the muscle	Can result in		
	Causes muscle contraction	postsynaptic Does not cau		
	Presynaptic bulb is a flattened shape	Presynaptic		
	Tresynaptic bails is a natteried snape	Tresynaptic		
	<ol> <li>An infolding of the sarcolemma which increases th This means that the depolarisation can be in closed can cause it to open the calcium ion channels.</li> </ol>			
	1. 1. Tropomyosin covers the binding sites on the	actin, so myosir		
3 79 Edward	The myosin head is bound to ADP.  2. Calcium ions bind to the troponin/tropomyos binding sites. Myosin head binds to actin at the (Calcium ions also stimulate ATPase activity in 3. The myosin head tilts – the power stroke. The is released.  4. An ATP molecule binds to the myosin head and is broken.  5. The ATP is hydrolysed into ATP and a phoshad the myosin head The ALP mains bound to 6. The myosin head The ALP mains bound to 6. The myosin head The ALP mains bound to 6. In the myosin head they cause the vesicles complete in the myosin head they cause the vesicles complete muscle tissue, they are released from the sall troponin/tropomyosin to cause tropomyosin to most an another same length.	the binding site in the myosin he also results in myosin he also the myosin reticoplasmic retic		
<ul> <li>b) Stays the same length</li> <li>c) Shortens</li> <li>4. The muscle would not get shorter. The myosin tails are anchor pull on each other and causes actin to slide along the myosin. It tails were not attached to each other – they would crawl along but the Z lines would not get closer to each other.</li> </ul>				



Task number	Answers
3 cont.	<ol> <li>No impulse in the motor neurone – this would mean no neurotrar depolarisation of the sarcolemma. Therefore, the sarcoplasmic regions. The calcium ions would detach from the troponin/tropomyc covered up – no more cross bridges can be made.     Lack of ATP – this is needed to break the cross bridges and reposit Phosphocreatine contains a phosphate group that can be hydrolysmake some ATP.</li> <li>To maintain a high level of aerobic respiration in order to make er contraction for long periods of time.</li> <li>Extension: Calcium ions cannot be pumped back into the sarcopla respiration happening to provide the ATD in his means that calcium sarcoplasmic reticulum and allowing the ATD in his means that calcium sarcoplasmic reticulum and allowing the ATD in heads to bind to the act actin along the myosin (contracted).</li> </ol>
Quick	smooth, string ov floril, sarcolemma, acetylcholine, receptors, sodii
recap	sar and said reaculum, slide, shorter, ATP, creatine phosphate / phosp
Extension	hele is a plethora of examples. The poster should cover the different or example:  Inhibition of release of neurotransmitter  Mimicking the neurotransmitter by binding to postsynaptic recept or inhibiting it  Inhibiting acetylcholinesterase







#### 7. Photosynthesis

Task number			Answers	
	1. Outer membrane	Str	oma	
Getting going	Inner membrane  2. Carbon dioxide + Wa  3. 6CO <sub>2</sub> + 6H <sub>2</sub> O	G C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> +	lucose + Oxygen	
77.	1. The phyll a chlorophyll b / xanthopl Green light as this is not 5.		very well by the p	olants
1	6. Some wavelengths of lig Some wavelengths can't Blue light has a shorter was the overall light inten	penetrate the www.wavelength and i	rater at all. s able to penetra	te the w
	will therefore be able to			
	1. Action			
	Bung/lid on the chroma	tography tube	To saturate the a	air in the
	Origin line drawn in pen		F ncil will not di	
	Solvent line recorded withe top of the paper	The second secon	To record the so becomes not vis	
	Wearsing		To avoid contam	ination
	. per should be place	ad so the origin	solvent doesn't g	get on 🕅
, <b>1</b>	line is above the level of t		So the sample do	oesn't d
	The paper should not to of the tube	uch the sides	To ensure the sa avoid solvent cor	
	They have different solu	bilities in the sol	vent	
	Pigment	Distance fro	m origin (mm)	
	Carotene	<del> </del>	38	
	Chlorophyll a	-	51	
	Xanthophyll		18	

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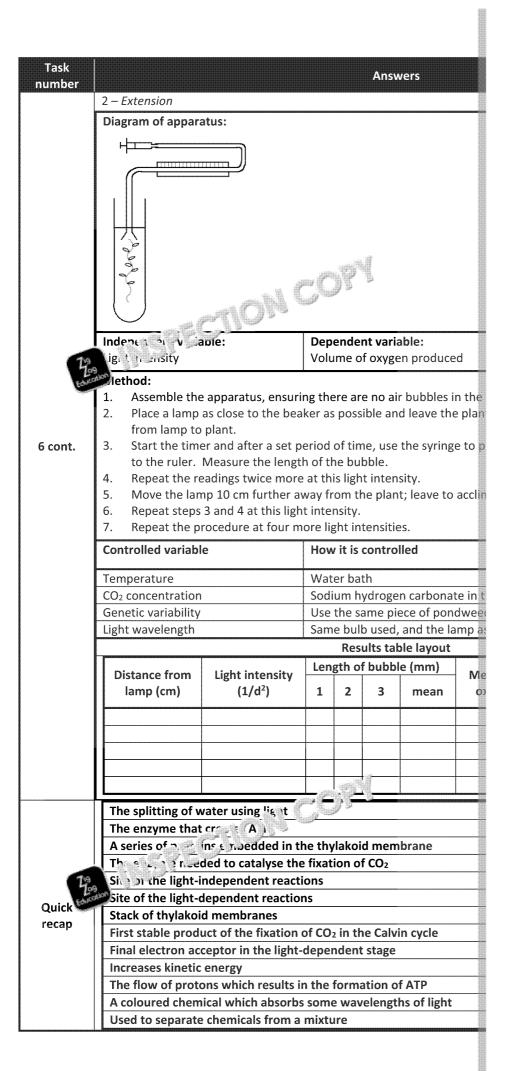


<b>T</b>	
Task number	Answers
10.110.0	4. It is a ratio
2 cont.	5. 0
	6. The molecules in the sample might have different solubilities in d
	1. The use of light to add a phosphate group onto a molecule
	2. Thylakoid, phospholipid bilayer, proteins, chlorophyll, electron tr
	ATP synthase, stroma, ATP, chemiosmosis
	3. 1 – Light hits photosystem II and is absorbed by chlorophyll 2 – A pair of electrons becomes excited and leaves the chlorophy
	the electron transport chain, releasing energy as they do so, and
	3 – The energy is used to pump protons into the thylakoid space.
	electrochemical gradient.
	4 – The protons flow down the தூர் டி through a protein chann
	ATP synthase
3	5 – ATP synthag, a last parameter of ADP to create ATP
3	6 – انق المنافقة المنافقة 6 – انقل المنافقة الم
<b>6</b> 19	Light splits water into electrons, protons and oxygen (photoly
	replace those it has lost, protons add to the electrochemical grad
	4. ATP, reduced NADP, oxygen
	5. This is essentially the same as you will have learnt about plants.
	The bacteriorhodopsin is a pigment and absorbs light. This cause
	are passed to electron carriers.
	The energy from the electrons is used to pump protons across the of the bacterium).
	There is a build-up of protons which creates an electrochemical g
	The protons diffuse through the ATP synthase, allowing ATP to be n
	1. ATP and reduced NADP
	2.
	60
	CO <sub>2</sub>
	Unstable in
	RuBP
	To be a second of the second o
	The Calvin cycle
	The Calvin Cycle
4	
-	Reduced NADP
	Reduced NADP
	ADP +Pi
	/
4	NADP
T.	
	ATP TP/GALP
	IF/GALF
	<b>▼</b>
	Hexose sugars
	ļ
	W W



Task number	Answers					
4 cont.	<ol> <li>Rubisco</li> <li>It doesn't need light to happen, but it does need products from the dark these would not be produced and the cycle would not happe</li> <li>Starch, cellulose</li> <li>It is used to regenerate RuBP</li> <li>No/less ETC = no/less ATP and reduced NADP produced. This resulthese products are needed for this step, so less hexose sugars can respiration and less growth.</li> </ol>					
Zig Edward	1. CO <sub>2</sub> availability: Increase would mean more CO <sub>2</sub> can be fixed made, and, therefore, more hexose sugars.  Temperature: Increase in temperature in increase kinetic enzyme-controlled reactions. To libraris, above 30 °C, will decrease growth rot.  Light intensity conscious light intensity means more light produced area action, increase in light intensity means more anged.  Light intensity. At this point, if the light intensity is increase Temperature or CO <sub>2</sub> concentration  4.	energ , more can be re stor				
5	Rate of oxygen production					
	Light intensity					
	<ul><li>5. Oxygen is produced in the LDS during the photolysis of water increase in rate of oxygen produced.</li><li>6. Volume of oxygen produced, and the time it was produced</li></ul>					
	1. For					
6	O <sub>2</sub> is produced by a plant during photosynthesis  O <sub>2</sub> Reasons against using CO <sub>2</sub> can be used as reasons for using O <sub>2</sub>	Some (Some (				
72	CO <sub>2</sub> is uncertaint, notosynthesis  CO <sub>2</sub> is uncertaint, notosynthesis  CO <sub>2</sub> is uncertaint, notosynthesis  regularity using O <sub>2</sub> can be used as  regularity usons for using CO <sub>2</sub> t	CO <sub>2</sub> use espira he ext t migh t woul				







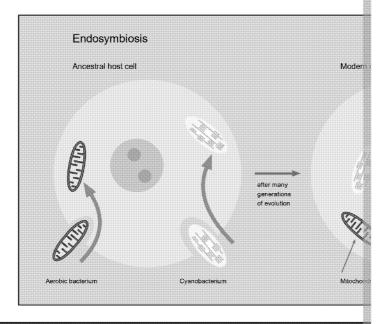
#### 1. Could be done using a table or a Venn diagram, and should include limited to it. Photosynthesis Reactants Carbon dioxide and water Products Oxygen and glucose

	Photosynthesis
Reactants	Carbon dioxide and water
Products	Oxygen and glucose
Reactions/stages	LDS and LIS
Requires ATP	Yes
Generates ATP	Yes
Uses chemiosmosis	Yes
Final electron acceptor	NAC
Main organelle involved	Chicaplast
Organisms it occurri	Autotrophs
Coenzy Inv lea	NADP

nbiotic theory is about the evolution of the eukaryotic cell and mitochondria were once cells in their own right, probably typengulfed into a larger cell, which is now what we know as a eukar

**Extension** 

Task

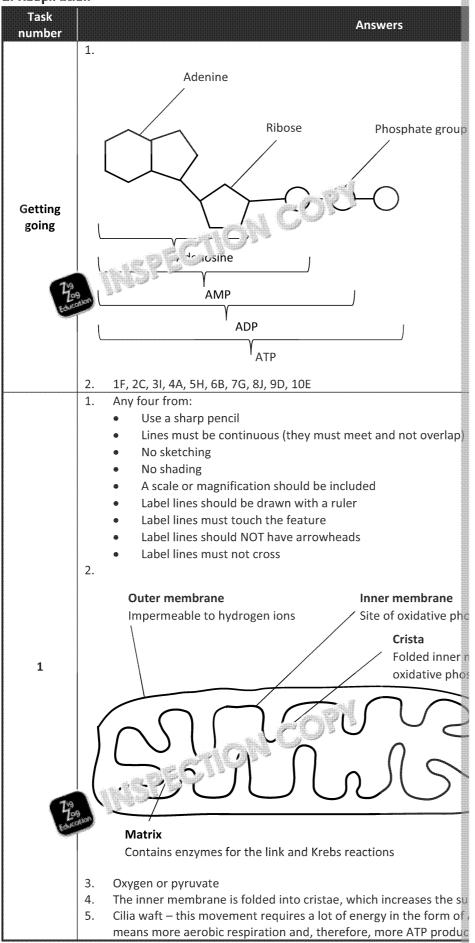


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#### 8. Respiration



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#### Task Answers number 1. Glucose 2 × ATP 2 × ADP Phosphorylated glucose (hexosc 1 6 bisphosphate) 2 × triose phosphate (TP) / GP 4 × ADP 2 × NAI $4 \times ATP$ 2 × r 2 × pyruvate 2. 2 NAD Synoptic: Lock and key theory: The enzyme has a specific 3D shape. The shape of the active site substrate. The substrate binds to the active site, forming an enzy The activation energy is lowered and the reaction occurs. The proenzyme is unchanged and can immediately bind to another substitution Induced fit theory: The enzyme has a specific 3D shape. The shape of the active site substrate to bind to the active site, forming an enzyme-substrate around the substrate. This puts strain on the bonds in the substra The products leave the active site. The enzyme is immediately ab TP/GP could not be turned into pyruvate as NAD is required for the Glycolysis happens in the cytoplasm. / The enzymes needed are in mitochondria has no cytoplasm and, therefore, cannot carry out 1. NAD Reduced NAD Pyruvate acetyl group combines with a 4C compound (oxaloacetate The 6C compound is decarboxylated and dehydrogenated to for accepted by NAD to form reduced NAD. - The 5C compound is decarboxylated again to form a 4C compo - This 4C compound is dehydrogenated in order to be turned bac - The H are again accepted by NAD to form reduced NAD, and als - ATP is also produced. **Decarboxylation** – removal of a carbon atom from a molecule **Dehydrogenation** – removal of a hydrogen atom from a molecule **Substrate level phosphorylation** – production of ATP through a ADP during a chemical reaction Oxaloacetate is constantly being produced but is also constantly

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#### Task **Answers** number 1. Matrix Phospholipid bilayer of the inner mitochondrial membrane Intermembrane sh Electron transport chain The energy is used to pump the hydrogen ions from the n 2 The H is split into protons and electrons. 11 Oxygen also accepts protons, and, therefore, forms wat The hydrogen ions flow down the electrochemical gradient 7 specialised channel protein in the inner membrane. The electrons flow down the electron transport chain the 4 releasing energy as they do so. 1 NAD and FAD are oxidised, releasing the H, and are reform 10 The electrons in the ETC are accepted by oxygen (the final 3 The electrons are accepted by the first electron carrier in This results in more hydrogen ions in the intermembran 6 an electrochemical gradient. 4 The channel protein has ATP synthase attached on the m 8 The flow of hydrogen ions through ATP synthase causes a phosphate group - this is known as chemiosmosis. 3. NAD Reduced NAD 2H H<sup>+</sup> $4H^+ + 4e^- + \frac{1}{2}O_2 = H_2O$ The final electron acceptor. It accepts electrons from the ETC; the accept more electrons, so the production of ATP can continue. The hydrogen ions would have dissipated. There would be no ele there would be no chemiosmosis.

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#### Task **Answers** number 1. Acts as the final electron acceptor The ETC would stop. NAD would remain reduced. There would 2. reaction and Krebs cycle would stop. 3. Mammalian cells: Reduced NAD NAD 2H 5 Reduced NAD CO, Ethanal Pyruvate Only glycolysis happens, which produces a small amount of ATP. 4. not occur. 1. It reproduces rapidly, conditions can be easily controlled and the do either aerobic or anaerobic respiration under the right condition 2. Temperature, pH, type of respiratory substrate, concentration of of respiring tissue, time, presence of inhibitors 3. To absorb the carbon dioxide released by respiring organisms Towards the respiring organisms. Oxygen is used, carbon dioxide absorbed by the sodium hydroxide solution. Therefore, the total decrease the pressure in the tube containing the organisms. The 6 lower pressure. 5. By placing the equipment in a thermostatically controlled water by respiratory pathways will be affected by temperature. 6. To allow the equipment to equilibrate, and for the organisms to 7. To allow comparisons to be made, so that a value for rate of resp be found 8. By using the syringe Yeast suspension used instead of small organisms. A tube would experimental tube. No sodium hydroxide, and a layer of oil needs Anaerobic, oxygen, more, glycolysis, pyruvate, ATP, matrix, Krebs, phos Quick chemiosmosis, acceptor, reduced, cytop' recap Examples of scientists could include Artume Lavoisier, Jan Ingenhous **Extension** Gustav Embden.



NASPE

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#### 9. Stem cells, mutations and gene expression

3. Stem cells, mutations and gene expression						
Task number					Answers	
	DNA is copied into mRNA using RNA polymerase					
	1	At a ribosome				
	1			read, two codons at		333
Getting				bind to complementa	ry codons on n	nRNA
going	1	tRNA brings a sp		c amino acid s between two amino	acido	
	1			along the mRNA unti		is reach
	1. 2.	A cell that can d	ivide	and then differentiat	e into specialis	ed cells
			(	Cells they san dif a er	ntiate into	
		Totipotent		Cr. I		A fert
		Totipotent	L			early e
		l ic jotunt		embryonic cell (any o y but not placental tis		Cells o
		Multipotent		eral cell types	,	Adult
						progen Skin ce
		Unipotent	Only	y one cell type		(prod
	3.	Synoptic				
		Cell name		Function	Specialis	ation
		Erythrocyte	Transports oxygen from the lungs to respiring	Biconcave shape		
				1 -	Flexible	
				No nucleus,		
				tissues	mitochondria, ER and little cytoplasm	
					Many haemoglobin	
					molecules	
1					Many cell sur	face
					receptors	
					Many lysosor	nes
				Engulfs, destroys	Manyribosan	
		Neutrophil		and digests	Many ribosor rough ER	iles /
				pathogens		
				$C^{y}$	Many Golgi	
		1.2929			Well-developed	
a de					cytoskeleton	
	<b>9</b>	Squamous	Covers and lines	Thin and flat		
		epithelial cell	free surfaces in the body		Smooth surface	
	4.	Induced pluripo	tent (	stem cell. A multipote	ent stem cell th	nat has h
				g and suppressing ce		141 HOS W
5. The stem cells will produce cells that are genetically identical to will express the same glycoproteins on the surface of their cells less likely to be an immune response as these glycoproteins wi				tical to		
				ins will		

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Task			Anguera				
number			Answers				
	6.	Embryo	onic stem cells come from an embryo that is left over from				
_		•	red. Some people believe that life begins at fertilisation ar				
1 cont.			r is ethically wrong – the end does not justify the means.				
			use and destruction of embryos. Using iPS cells means emi				
	1.		(accept short pieces of RNA)				
	2.		anscription factor				
			omotor region				
			NA polymerase				
			ene				
		5. Tr	anscription				
		6. m	RNA				
		7. Tr	anslation				
		8. Pr	otein				
	3.	The tra	nscrip*'; 1 o kinds to the promotor region				
		This a''.	ງ ່າ ໄປ ເປັນເຂົ້າ viymerase to bind				
2		7 'A .	lymerase transcribes the gene (the gene has been express				
		he res	ulting mRNA is translated into a protein at a ribosome				
	2	When t	he transcription factor binds, this will stop RNA polymeras				
	Ī	turned	off				
	5.		on-coding region of DNA				
			oding region of DNA				
			ne RNA that is transcribed from DNA – all of DNA is transcr				
	6.		on: The preRNA / primary RNA has the third intron remove				
		remain – these are translated into a protein which is coded On the right, the second intron is removed but the third rer					
		a slightly different structure than the left side.					
		The two proteins will have the same start and end (star and or in the middle (some or zig zeg shape). Both are coded for but					
	-		niddle (cone or zig-zag shape). Both are coded for by the				
	1.		e and galactose				
	2.	Glycosi Hydroly					
	3. 4.						
	4.		<ul> <li>permease – increases the ability of the bacterium to take lactosidase – catalyses the hydrolysis of lactose into gluco</li> </ul>				
	5.	_	3E, 4B, 5F, 6D				
	6.	10, 24,	32, 40, 31, 00				
	0.	3	The repressor protein hinds to the energies				
		6	The repressor protein binds to the operator region  The enzymes are not produced				
		<b>-</b>					
		2	A repressor protein is made				
3		4	The RNA polymerase cannot bind to the promotor region The regulator gene is expressed				
		5	The structural genes cannot be transcribed				
		5	The structural genes cannot be transcribed				
	7.	The reg	ulator gene is expressed				
		_	ssor protein is produce				
		Lactose	binds to the or or tein				
			anges Le Silveroi the repressor protein				
		The "	ι ως οιein cannot bind to the operator				
a > \ \ \ \ polymerase can now bind to the promotor							
he structural genes are transcribed							
100		The enz	zymes are produced				



Task						Δ	inswers				
number											
	1.		iange to the sec								
	2.		rtion involves o			being ad	lded to tl	ne sequenc			
			etion involves re								
			stitution is whe								
	3.		ere every subse	quent co	don is ch	anged ar	nd, there	fore, ever			
			fferent								
			GTC GTC GTC A	TAA AAT	TCTTTA	GGG					
	4.	4. a)									
			DNA	TAC	GTC	GTC	GTC	AAA			
			mRNA	AUG	CAG	CAG	CAG	UUU			
			Amino acid	Met	Gln	· <u> </u>	Gln	Phe			
		b)	TAC GTC GTC	GTC / A	A C تر.	TA GGO	3				
		•	T has beer					sequence.			
			UUC hisa s	CONTROL - 1000 - 1000				*			
			າ ne scode.	This is a	silent mu	u <b>tation</b> a	nd will h	ave no effe			
<b>1</b> 9		1	TAC GTC GTC	GTC AAA	AGT TCT	TTA GGC	3				
			A has been <b>su</b>	bstituted	l for G in	the sixth	codon.	This will be			
			which codes for	or the an	nino acid	Ser inste	ad of Leu	ı. This me			
4			changed, which	h might	affect the	bonding	g betwee	n R groups			
			the 3D shape.	The pro	tein's fun	ction mi	ght be al	tered. This			
		d)	TAC GTC GTC	GTC AAA	AT TCT T	TA GGG					
			An A has been	deleted	in the six	th codor	n. This re	sults in a			
			codon is chan	-	therefor	e, every	amino ad	id after th			
			heavily affecte								
	5.		rtion or deletio								
			Ithough one co				e followii	ng codons			
			amino acid wo		-						
	6.		bstitution muta								
	7.	a)	The allele con		_			-			
			to reproduce a				ie next ge	eneration.			
		h١	the allele in th	-			lai+b +b	اد مالمام مد			
		b)	Allele confers		_						
			reproduce, so frequency of t					i on to ons			
		c)	The allele free			-		inn nressi			
		٠,	or a disadvant			-					
			to chance.		,	que	., 0	uncie min			
Quick	diffe	erenti	ate, totipotent,	any, eth	ical, gene	es, specia	lisation.	organelles			
recap	1		r, insertion, prir		_	, ,	,	0			
•	<del> </del>		uld include:								
	• "		es of stem cell								
	•	• • •	ins of stem cells	5							
	•	_	differentiation								
Extension	•		trol of cell diffe	re H.	)	/ **					
	•		of stem		ne and re	esearch					
	All	i s	ula be linke	d to the	importan	ce of ste	m cells.				
	8.		******								
	100000										



#### 10. Body plans, cloning and biotechnology

Task number	Answers
	1. Possible words include, but are not limited to: genetically identic
Getting	variation, Dolly the sheep, artificial, natural, strawberries
going	2. A protein or non-coding RNA that binds to DNA at a specific base
	1. Cell division that results in the formation of two genetically iden
	2. Plans, homeotic, anatomical, homeobox, 180, protein, homeodom
	3. 60
	4. Animals, plants and fungi
	5. Animals
	6. The fly will transcribe the <b>mouse</b> gene into a transcription factor;
	transcription of other genes which the development of a fl
	7. The fly will transcribe the first engagement of the fly antennae
1	This will lead to the action of factors being produced which turn
	in the wr aplace the fly will have perfectly formed legs wher
	8. Et s in Tiese genes have been <b>conserved</b> throughout evolut
4	e / similar between lots of very different organisms. This impli
	common ancestor which had these genes, and they have not cha
W.	9. Controlled cell death
	10. To prune cells – for example, between the digits
	11. To remove cells which are genetically mutated or no longer need
	T lymphocytes. The rate of mitosis should equal the rate at which
	1. Asexual reproduction
	2. Reproduction can still happen even if there is only one individua
	If the characteristics of the parent suit the environment, the cha
	same. They will be adapted to the current conditions.
	It is relatively quick, so the offspring can take advantage of the a
	3. Lack of genetic variation leads to no or little variation in character
	selection cannot happen if the environmental conditions change
	If one individual is susceptible to a change, such as a new pathog
	4. Any two from: bulbs, corms, runners, suckers, leaflets, rhizomes
	5. Error in step 1: Piece of plant tissue was from anywhere
2	Improvement: It should have been only from a meristem area
	Error in step 1/2: The explants may contain pathogens
	Improvement: Sterilise the explants with bleach or alcohol
	Error in step 2: The explants were placed on gel containing auxin
	Improvement: The gel also needs to contain nutrients for growth
	Error in step 2: There may be pathogens on the agar
	Improvement: The agar should be sterilised
	Error in step 3/4: Callus was not divided
	Improvement: The callus needs to be divided to provide multiple
	Error in step 4/5: Auxin on one plate and cytokinin on the next
	Improvement: Both plates should have how hormones but in dif
	1. Any one from: identical twins, do no reenfly
	2. a) Meiosis
	b) Mitosis
	c) The especiones of each other
	် ု မကျော်ryonic cells are undifferentiated stem cells. They a
	they are divided up, each smaller ball of cells can still under
	An ovum from sheep A has the nucleus removed to produce an e
3	A cell from the mammary gland of sheep B has its nucleus remov
3	The nucleus from sheep B is inserted into the empty egg cell from
	This reconstructed cell is now allowed to grow into a ball of cells
	4. Any cell from the body that is not a gamete
	5. Sheep B
	6. Cloning cells, tissues or organs
	7. a) There are ethical issues involved – is it ethically right to creations.
	b) This will not increase genetic diversity, so the population m

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Task			An	swers
number			211	
	1.	Any three from:		
		They reproduce quickly		
		They can be genetically	engineered	
		There aren't many ethic	cal issues surrounding the	eir use
		They can produce prod	ucts at lower temperatur	es than chemica
		They can be grown any	where in the world	
		They are relatively easy	and cheap to grow	
	2.	a) Detect the pH leve	el so that it can be adjust	ed if necessary to
4		enzymes in the ba	cteria to be at their optir	mum pH, so the r
7		b) Provides oxygen, a	as most of the microorga	nisms involved a
		c) Enables the tempe	erature to be kerical the	optimum for the
		of reaction is as hi		
	3.		un an microorganis	ms. These would
		toxins. This was a shi	<i>*</i>	
	4.		rything at the start, nothir	
		_	rough the complete grow	- 3
		***	utrients are added and to	oxins are remove
	22	microorganisms at a sp		
	1.		ith the wanted microorg	-
			oduce products that are	toxic to the want
	2.	Autoclave		
	3.	Any four from:	1 m, 11 1 1 1	
			e and after the practical	
		Disinfect the work surfa	ice perore and aπer on for the entire duratior	
		Only lift the lid of the P	es after opening and before	ore closing
		·	pment should be dipped	in alcohol and fl
	4.	Any metaror glass equi	pinent should be dipped	in alconor and ne
	<del></del>			
g			Add <b>9</b> cm <sup>3</sup> of	Add <b>9</b> cm³ of
5			distilled water	distilled wat
			ı	ı
		A -1 -1 -1 -1 -1		
		Add 1 cm <sup>3</sup> of stock solution	$\setminus$ $\triangle$	$\Box$
		Stock Solution		
				3 ₩
			1 cr	n <sup>3</sup>
		Resulting concentration	1 in 10 / 0.1 / 10 <sup>-1</sup>	1 in 100 / 0.01
		<b>3</b> · · · · · · · · · · · · · · · · · · ·		, , , , , , , , , , , , , , , , , , , ,
			,_,,	
	n	11575		
<b>U</b> i				





#### $32 \times 10\ 000 \times 2 = 640\ 000$ 6. Number of bacteria 5 cont. Time (hours) A3, B1, C4, D2 7. A batch culture is used to colle a succe cary metabolites. This is b stationary phase. In ,...'\ reuen the stationary phase, there mu removal of tana. 1. An a. a specific tertiary structure which gives it a specific in a live site is, therefore, a specific shape and is complementar uinds to the active site and forms an enzyme-substrate complex the active site as they are not complementary in shape. a) Enzyme and product The enzyme needs to be removed and this will increase the active site, substrate, adsorption, shape, broken, product, covale Any three from: Volume of starch Concentration of starch Temperature рΗ Size/shape/number of beads 6 The speed of flow of the starch The product would be maltose – a reducing sugar. A range of known concentrations of maltose would be subjected to reagent and heat to 80 °C for 3 minutes. The precipitate would be filtered out and then the transmission a colorimeter. This would be used to produce a calibration curve. The product from the experiment would then be treated with Ben same way, the precipitate filtered out and the transmission measu This would then be used to read off the calibration curve to give Any two from: The enzymes are more stable, so a higher pH and a greater range The enzyme is not mixed in with the product, so the cost is lower The enzyme can easily be reused Immobilising enzymes using ionic bonds a) b) Exponential growth phase Absence of unwanted microorganiam. c) Nutrients are added and wester noved constantly d) Quick The use of living and nieng am producing something humans need e) recap f) Creating netically identical cell, tissue, organ or whole organis 4 ). In note that stimulates growth reauction of thousands of genetically identical plants Genes that control the body plan The poster should be well laid out, eye-catching and focus on the advan Grown on waste products so reduces waste High protein content No animal welfare issues Extension No saturated fat Not much land used No cholesterol

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#### 11. Inheritance

. Inheritance		
Task		Answers
number	1F 2A 2D 4D FF 66	
	1E, 2A, 3B, 4D, 5F, 6C	
going		
-		I — 1 1 1 1 1
	Homologous	Two chromosomes which have the same mother and one from the father
	Locus	
	Allele	Position of a gene on a chromosome  Alleles are different versions of the same
	Genotype	The alleles possessed by an organism
	Homozygous	Two of the same ses for a particular g
	Tiomozygous	The characteristics of an organism due to
	Phenotype	yp and the environment
	Heterozvg	different alleles for a particular gen
	D 1 2 1	Always expressed in the phenotype
	L :	Only expressed in the absence of a domi
(12,	Protein synthesis	Production of a protein
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	1
4	 Prophase 1	Metaphase 1
	n = vor ger n n dell tell tell tell	recommitted a
1		
		$\times$ /
	0	Talauhaan 4
	Anaphase 1	Telophase 1
	$\setminus$ $\wedge$	
3		es to up individually on the equa
		ne chromatid goes to each pole.
	Par پیش کی pes: ا r ن genotypes: F	
	e genotypes. I	, ·, · , ·
7		F f
		F FF Ff
2		F FF Ff f Ff ff
2		
2	Offspring genotypes:	f Ff ff

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Answer to the question: 25 % or 1 in 4

Phenotypic ratio: 3:1

	•				
Task				Answers	
number	2. a)				
	u)			Сн	Сн
				C <sup>H</sup>	C <sup>H</sup>
			Cc	Cc	C <sub>C</sub>
			Cc	CH	CH
			C	Cc	Cc
	Phenotypes: all pa	alomino			
	b)				
	, b)			CH	Cc
2 cont.			_ <mark>'</mark> с <sup>н</sup>	C <sub>H</sub> C <sub>H</sub>	C <sub>H</sub> C <sub>C</sub>
cont.			Cc	C <sub>H</sub> C <sub>C</sub>	C <sub>c</sub> C <sub>c</sub>
$\sigma_2$	types: 1 : 2 Parent genotype:		palomino : o	cream	
	Gamete genotype	•			
	,,	, , ,		XH	Υ
			XH	XHXH	X <sup>H</sup> Y
				_	
			X <sup>h</sup>	X <sup>H</sup> X <sup>h</sup>	X <sub>h</sub> Y
	Offspring genotyp	oc. VHVH VHV	vHv vhv		
	Offspring phenoty			al female (	(carrier), n
	1. Meiosis				
	2. Round and yellow			;	
	3. Parental genotype Gamete genotype			ıB. ab	
	7,	, , ,			- 0
		AB	AB AABB	Ab AABb	aB AaBB
3		Ab	AABb	Aabb	AaBb
		аВ	AaBB	AaBb	aaBB
		ab	AaBb	Aabb	aaBb
	Dhanaturaacaala			حاما ما م	
	Phenotypes: yello Ratio: 9 : 3 : 3 : 1	vv anu round,	yenow and v	villikieu, g	reen and f
	1. Any one of the ch	romosomes w	hich isn't a s	ex chromo	some. In
	chromosomes 1–2				
	<ul><li>2. Two genes are on</li><li>3. The genes cannot</li></ul>			rtment	
	4. Crossing over	anacigo muc	.pci, 1 3.	, ciricin	
	5. Parental genotype	- 10 - 10 F - 10 - 10 - 10 - 10 - 10 - 1			
	Gametes: YR,	'I " /I"			
4		<u></u>	YR	Yr	yR
4 17		yr	YyRr	Yyrr	yyRr
6	Phenotypes: yello	w long, yellov	v short, red l	ong, red sh	nort
	Unlinked expected	d ratio: 1 : 1 :	1:1		
	6. The genes are link				*
	chromosome as the short. Therefore,				**
	,				
	combinations are	as a result of	crossing ove	r occurring	between

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in smaller amounts as crossing over doesn't happen more than it

Task					Ai	nswers
number	4	5544				
	1.		, BBAa, BbAA, BbAa			
	2.	9:3:	3:1			
	3.			- I		
				B ab	_	
		AB		aBB AaBa		
5		Ab		aBb Aabb		
		аВ		aBB aaBb	_	
		ab	AaBb Aabb a	aBb aabb		
	4.	The g	enes code for protei	ns which migh	it be en	zvmes in a path
			ioning enzyme which		1,000	
			ent can be put into a	- 2000000000000000000000000000000000000	C.200 TOOL T	
	1.		Aa		, io <b>,</b> oii	<u> </u>
			aa			
		c) ,	1			
	2.	120	∮ from:			
G.		านเง	iduals 1 and 2 are una	affected but h	ave an	affected child. T
6		If it w	vas dominant, an affe	cted individu	al must	have at least or
***		the a	ffected/dominant all	ele from.		
		Also	11 and 12 produce 1	5.		
	3.	If it w	vas on the X chromos	ome, individu	ıal 15 m	iust have two re
		chror	mosome. She must h	ave got one o	of these	from her father
		also l	have the disorder as	ne is a male a	nd so h	as only one X ch
	1.	Categ	gorical			
	2.	,	9:3:3:1			
			Purple jagged 81			
			Green jagged 27			
			Purple smooth 27			
			Green smooth 9			
		c)				
			Phenotype	Purple ja	gged	Green jagged
			Expected ratio	9		3
			Expected number	81		27
			Observed number	86		26
			fo – fe	5		-1
			$(f_o - f_e)^2$	25		1
			$(f_o - fe)^2 / f_e$	0.309	)	0.037
7						
		(	Chi-squared value: 0.	79		
	3.					
		Des	grees of freedom		T	Probability (
		<u> </u>		0.1		0.05
			1	27:		3.84
			2	1		5.99
			3	6.25		(7.82)
	1			7.78		9.49

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probability that the difference between f<sub>o</sub> and f<sub>e</sub> occurred by chan hypothesis – there is no significant difference between f<sub>o</sub> and f<sub>e</sub>.

P is less than 0.05. There is a less than 5 % probability that the diff chance. This means we reject the null hypothesis – there is a significant difference between f<sub>o</sub> and f<sub>e</sub>.

Task number	Answers
	<ol> <li>Genotype: the alleles possessed by an organism         Phenotype: the observable characteristics of an organism, often c and the environment         Dominant: an allele that will always be shown in the phenotype         Codominant: when both alleles are expressed in the phenotype         Recessive: an allele that is only expressed in the phenotype in the Autosomal linkage: the inheritance pattern of two genes that are Sex linkage: the inheritance of genes found on the sex chromoson     </li> </ol>
	Z.  T t  T TT Tt  t Tt tt
	Shaded squares ( d l e an; unshaded would be short  3. Other to cape used, and accept the use of just B and W with
Quic. 4 recap	C <sub>B</sub> C <sub>B</sub> C <sub>M</sub> C <sub>M</sub> C <sub>M</sub>
	CBCB — black  CBCW — chequered  CWCW — white  black: chequered: white in a ratio of 1:2:1  4. Accept letters other than B  It is best to use the Xs and Ys as shown, but accept if just B / altern NO LETTER where the Y would have been
	XB         XBY           XB         XBY           XB         XBY
	X <sup>B</sup> X <sup>B</sup> — normal female X <sup>B</sup> X <sup>b</sup> — normal female (carrier) X <sup>B</sup> Y — normal male X <sup>b</sup> Y — colour-blind male
Extension	One example of inheritance of: sex linkage, dominant and recessive monohybrid, a dihybrid, autosoma







#### 12. Manipulating DNA

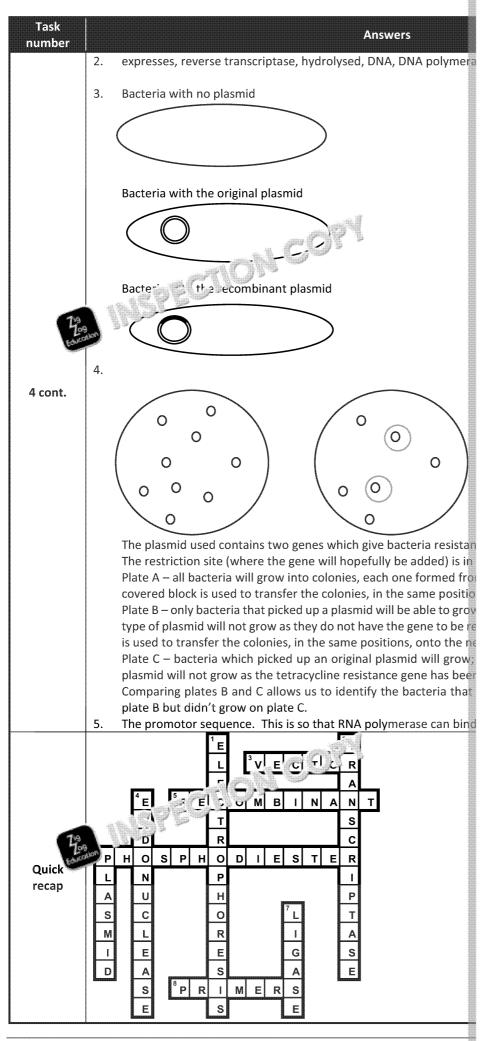
12. Manipula	ting D	NA .		
Task number			Answe	rs
	1.			
		Phosphate group		
			Nitrogenous	base
		Y		
Getting		$\lambda$		
going		/	/	
		Deoxyribose		
	_			
	2.	Phrip in PSCII		
The state of the s	3.	∕ , ∪iymerase Hydrogen (bond)		
	1000000000	One base will only bind with one	other specific hase	A with Tand
	<del>                                     </del>	I. To break the H bonds between	•	
		<ol> <li>To allow primers to anneal t</li> </ol>		* 3000
		3. To allow DNA polymerase to		
		DNA nucleotides to the new		
		4. To produce many copies of	the DNA section	
	2.	To recognise and bind to the five		DNA section
		recognise the double-stranded se	ection.	
	3.			
			PCR	DNA replicat
		Involves DNA polymerase	✓	✓
		Produces DNA	✓	✓
1		Occurs in the nucleus of cells		✓
_		Involves heating and cooling	✓	
		H bonds are broken	✓	✓
		H bonds are formed	✓	<b>✓</b>
		Needs free DNA nucleotides	✓	<b>~</b>
		Involves the formation of	✓	<b> </b>
	_	phosphodiester bonds		
	_	Involves primers	✓	
	_	Needs free RNA nucleotides		
	L	Produces RNA		
	4.	Number of copies – $2^{30} = 107374$	41 824	
	1	The mutation would get copied –		ks like there a
	1.	Restriction endonuclease. The en	active site د د س	is a specific 3
	1	particular sequence 🧥 📏 🐱	one restriction en	donuclease w
		sequence of Just s.		_
	2.	The 'E A SCONA would be ide		
<b>1</b>		enzymes will digest the D	NA at the same po	oints, leaving t
	3,00000	rhe negative electrode	will move away fr	om the negative
2	1	DNA is negatively charged and so one	wiii move away m	om me negati
_		one Shorter lengths have less resistar	ice from the gel wh	nile moving an
	1	gel at a faster speed. This means	_	
	1	the more resistance and the slow		
	1	particular time.	,	
	1	Suspect B did not leave DNA at th	ne crime scene, sus	pect C did. T
		suspect C committed the crime.		

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Task		
number	Answers	
	7. Father 1 is most likely out of the three possible fathers as	
	with the mother line up with father 1. However, there is	a band
	the fathers.	
	8. VNTRs/STR/microsatellites (short repeating sections of D	
2 cont.	are used. They vary in the number of times each section	
	people having exactly the same number of repeats at all This means these sections can be used to identify which	
	the entire genome.	person
	9. Extension: by the charge on the proteins	
	1. CTACG	
	2. A tag of some sort – radioactive or fluces int	
	3. So the single-stranded probe $\Gamma$ are ineal by complete	mentary
	DNA	
	4. Extension: by the halling solution	
	5. To ren will bound probe – otherwise you might ge	
	6. rent 1 is heterozygous / Use of letters to show th	
16	Parent 2 is homozygous dominant / Letters to show	
65	<ul> <li>b) It is unlikely (not impossible) that any child from the because only one parent carries the recessive allele</li> </ul>	
3	recessive allele, not two.	, so the
	c) This parent is homozygous dominant. This means t	hat thev
	more of that section of DNA than parent 1. This me	1
	band will be bigger.	
	7. RNA nucleotides, RNA polymerase, phosphodiester, mRN	IA, nucl
	anticodon, hydrogen, specific, peptide, stop	
	8. $456 \times 3 = 1368$	
	9. Stop codons, introns that are spliced out	
	10. mRNA sequence would be AUGCCAUCCUGGCACGCAUGA	\; there
	be Met, Pro, Ser, Trp, His, Ala, stop	
	1. Biogram	
	Diagram  Chromosomal DNA fragment to be cloned:	Restr
	Chromosomai DNA fragment to be cioneu.	gene
		gene
		The s
		used
	A DNA plasmid from a bacterial co	D = =4
4		Restr
		way t restri
	749623° EXEMPLEMENT	of DN
		sticky
To the		If the
		plasn
		will a
		DNA
		DNA
		The p
		plasn
I		1 200001
		(acce







Task number	Answers
Humber	4. Provide la constant de la constan
	1. Research how a gene machine works
	The amino acid sequence of a protein is determined by chemical
	This is used to work out the sequence of bases in the RNA and, the RNA for the target and the RNA and the target and target and the target and the target and targe
	the DNA for that gene
	The sequence is typed into the gene machine, and the machine is
	The machine uses the code to join nucleotides together in the rig
	It does this in fairly short sequences
	The sequences are then joined together using their overlapping s  This gene can then be copied with PCR
	2. Research the genetic modification of soya beans
	Soya beans have been genetically engined d in various ways by
	For example, soya beans were facts yith the bacterium Agrob
	make them resistant to cac or glyphosate – a weedkiller.
	sprayed on the color was out having an effect on the soya beans
	Other has have been added to certain soya bean varieties
	a nposition. Increasing oleic and steric fatty acids, and deci
49	he beans are less susceptible to oxidation and will, therefore, ke
	Produce a poster to show the pros and cons of genetic manipular
<b>1</b>	Pros include:
	Microorganisms can produce useful products, e.g. insulin
	GM plants can be made which are resistant to herbicides –
Extension	GM plants can be made which contain chemicals useful to h
	GM plants can be made which are resistant to pests (increase).
	of pesticides)
	Animals can produce useful products in their milk
	Animals can be modified to increase milk/meat production
	Animals such as mice can have genes removed (knockout m
	Humans – removal of 'faulty' genes?
	Cons include:
	The potential for any of the genes used to 'escape' and becomes the second of the genes used to 'escape' and becomes the second of the genes used to 'escape' and becomes the second of the genes used to 'escape' and becomes the genes used to 'escape' and '
	population – the effects of this are unknown
	The use of marker genes – the possibility of antibiotic resist.
	populations of bacteria
	For many of the plant modifications – who benefits? The fa
	The modified organisms are mostly infertile – this means fa
	every year instead of keeping seed from the previous year
	Animal welfare issues
	Religious views about the use of certain animals
	Germline therapy in humans is considered unethical, and so
	designer babies
	4. Student's own response
	10 19 19 Carlo 18 19 19 19 19 19 19 19 19 19 19 19 19 19
(12)	
Edward Comment	





#### 13. Measuring ecosystems

13. Measurii	1g ecosystems
Task number	Answers
number	a) Population sizes rise and fall, populations interact with eac
	environment, small changes in biotic or abiotic factors affe
	prey interactions, soil nitrogen
	b) The elements return to where they started; there is no beg
	nitrogen and carbon are continuously moved between aspe
Getting	eventually end up in the same place that they started.
going	c) Energy is not recycled – it flows through an ecosystem, star
going	not return to the Sun.
	2. A feeding level within a food chain or web
	3. There are many different examples note ng:
	d Sun → Oak tree → at€ n' a. → Blue tit →
	It must start with the second en mave a producer, then a primary
	consumer a unit si i ve a tertiary consumer
	1. Holica in a comm
<b>1</b> 9	the role of an organism in an ecosystem
	Population – a group of organisms from the same species which
The second second	time and can interbreed to produce fertile offspring
	Community – all the living organisms from all species which live
	can interact
	<b>Ecosystem</b> – all the living organisms and the non-living factors w
	2. <b>Producer</b> – an autotrophic organism that obtains food from inor
	or chemosynthesis
	Consumer – a heterotrophic organism which obtains its food in
	indirectly from producers
	<b>Decomposer</b> – a saprophytic organism, or a detritivore which ob
	waste material
	3.
	Energy in <b>sunlight</b>
	Links in one
	Light is ref
	Energy transduced in <b>photosynthesis</b> to
	produce glucose
1	Glu
	Chemical energy left in plants
	Chemical chergy certain plants
	Some m
	Chamical anargy ingested by consumore
	Chemical energy ingested by consumers
	Some
	Chamical a set of the consumers (e.g.
	Chemical F y or ted by consumers
	Respir
	Chemical energy used for <b>growth</b> by
69%	
	consumers
	4. The flow of energy
	5. NPP = GPP – Respiration
	6. The gross primary productivity is the total quantity of light energ
	energy. The net primary productivity is the chemical energy, wh
	their own needs in respiration.
	•
	7. $kJ m^{-2} yr^{-1}$

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	ı								
Task number					Answers				
	8.	There are many	/ suggestions p	ossible. Some	examples inclu	de:			
		<ul> <li>Using pest</li> </ul>	ticides. Pests d	lamage the cro	os, and will red	uce t			
		using chemicals that kill them will increase productivity.							
	<ul> <li>Using fertilisers. Minerals such as nitrates are absorb</li> </ul>								
		plants. Pl	ant growth will	therefore be li	mited by the a	vailab			
		Adding fe	rtilisers increas	es the mineral	content of the	soil, s			
		therefore	so will product	ivity.					
			-	monoculture.		300			
		· ·		directed to ma					
		-		fertiliser used					
1 cont.			_	This incressed t					
				the lied en who					
				s these tech		an be			
				will increase yie					
	9.	Use of the control				n. Als			
4				o do these jobs		1 - 8			
T.		Some of the inc farmer. The me				388			
		to pay for the n	•			****			
		increase in yield			aying to neat t	ne bu			
	10.	a) 14 000, b) 18							
	11.	90 / 1600 × 100		000, 0, 2, 700					
	1.	······		ht angles to end	close the area t	o be			
				enerator to gen					
			-	oordinates and					
		·		key to identify					
		4. Repeat us	ing many quad	rats. Record re	sults in a prefa	brica			
		5. Calculate	the mean num	ber of organism	ns in one quadr	at.			
2		6. Multiply t	his by the num	ber of quadrat	s that will fit in	to the			
	population size of a species = mean number of individuals of								
		of the total habitat area covered by a single quadrat							
	2.	It is subjective,		et definitions /	species can be	ratec			
		by their abunda		_					
	3.	She would use		form of system	atic sampling.	Abiot			
	ļ	for example, lig							
	1. 2.	There is no sign	lificant correlat	ion between li	ght intensity an	id the			
	2.		Number of	Light		D			
		Quadrat	dandelion	intensity	Rank of	Ra			
		number	plants	(lux)	dandelions	int			
		1	2	150	1	111			
		2	5	145	3				
		3	6	2,	4				
		4	4	200	2				
		5	10	500	7				
			8	720	5				
3		F,	9	1000	6				
		0	12	1498	8				
· d		- X				333			
Ti-		8 9							
T.	3	*	15	1888	9				
		9			9				
743	Sum	9 10 of d <sup>2</sup> = 16	15	1888	9				
79.	Sum $r_s =$	9 10 of d <sup>2</sup> = 16	15	1888	9				
79	Sum $r_s =$	9 10 of d <sup>2</sup> = 16	15	1888	9				
To the	Sum $r_s = r_s = r_s$	9 10 of d <sup>2</sup> = 16	15	1888	9				
79	$r_s = r_s = r_s$	9	15	1888	9				
79	$r_s = r_s = r_s = r_s = r_s = r_s$	9 10 of $d^2 = 16$ $1 - \frac{6 \times 16}{10(99)}$ $1 - \frac{96}{990}$	15	1888	9				



Task number	Answers
3 cont.	<ul> <li>3. r<sub>s</sub> is greater than 0.65, which is the critical value for 10 pairs. This hypothesis – there is significant correlation (between the number is less than a 5 % probability that this correlation occurred by chad.</li> <li>4. Repeat the transect at different angles from the tree. Repeat the year. Record the distance of each quadrat along the transect.</li> <li>5. Mean of A = 58.2, mean of B = 41.8</li> <li>6. There is no significant difference between the mean height of the Table 1.5 states are the significant difference between the mean height of the Table 1.5 states are the significant difference between the means. There is a least of the table 1.5 states are the significant difference between the means. There is a least of the table 1.5 states are the significant difference between the means. There is a least of the table 1.5 states are table 1.5 states</li></ul>
	cell wall capsule (not always present) plasma membrane
	naked, circular DNA flagellum
4	free in the cytoplasm  2. Any two from: DNA, RNA, protein  3. The plants are eaten by the animals. The protein is digested into these amino acids to build their own proteins.  4. A close relationship between two species where both organisms be a. Nitrogen fixation, b. Feeding, c. Death, d. Excretion, e. Nitrifica  6. Denitrification. Arrow from nitrate ions to nitrogen gas in the air  7. The animals/plants die, but their bodies do not get decomposed This results in less ammonium ions and, therefore, less nitrate ions
72	This means plants cannot absorb enough nitrate ions Nitrate is used to make proteins and This growth; therefore,  8. The nitrates leach into the warder, so as slow-flowing streams at the nitrates cause the second from reaching the plants at the bottom of the algae between the bottom die – they will no longer be photosynthe mains of these plants are decomposed by aerobic bacteria. This reduces the oxygen content further, and the fish then die du.  There will be an increase in activity of denitrifying bacteria, as the nitrate content of the soil.
	There will be a decrease in activity of the nitrifying bacteria as the will not be increased as much. This results in a decrease in the overall nitrate content of the soil; the plants to absorb and use for growth.



#### Task **Answers** number 0 0 Quick S recap 0 O N Ε U T С Α I С 0 S Ρ T Fossilisation Fossil fuels Combustion Carbon dioxide in the atmosphere and in water Respiration Respiration Photosynthesis Carbon-containing molecules in plants Feeding **Extension** Deposition Phosphates in rocks Sedimentation √e \_nering and fertilisers Dissolved phosphate ions in soil and water Absorption Excretion Phosphate in plants Feeding

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#### 14. Populations and evolution

Task number						Answers	
Getting going	1.	1D,	2E, 3B, 4A, 5C				
	1. 2. 3.	avai	two from: collability, patho two from: wa	gens			
	٥.	ا	Time (hour	s)	Number	of bacteria	
			0	-		40	
			2			•	
			4				
			6			.68	
					3	36	
					6	72	
6			12		1	344	
		***	14		2	688	
			16		5	376	
			18			752	
			20			504	
			22			008	
			24		86	016	
1			Log <sub>10</sub> number of bacteria				
7-7-2-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-		d)	Its to with Linear scale There is a lag adjusting to available. The few toxic profastest rate. The populati	e (hour. ) % of the in half a s on both a g phase — the new onen the re oducts. T	e graph paper equare, as per xes the population conditions, e.go est of the time the population on will start to con	used in the pathe table on does not in g. making enze is the log phaincreases radecrease, and	ncrease at the symes needs ase — high repidly as the
		f)	of the bacter	ia will the	rces and build in die due to la tition for mat	ack of nutrien	its and build

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Task			Answers	
number			Allsweis	
	1.	The pre	y population decreases = less food for the predators = few	
		reducti	on in number of predators. This leads to fewer predators $\epsilon$	
		numbei	rs = more food for the predators = predator numbers incre	
			se again.	
	2.		ecosystems, a prey species has more than one predator, a	
			numbers might not directly influence each other in the wa	
			ase, or any change in abiotic factors.	
	3.		ecific competition – competition between members of diff	
2			ecific competition – competition between members of the	
	4.		aurelia – Population increases rapidly from 0 on day 0 to 17	
	''		creases more slowly to a peak of and any 14. Then the pe	
			caudatum – Population (ea ), with fluctuations, from	
			en the population specific also to 57 on day 16.	
			here is in a control competition between them. <i>P. aurelia</i>	
		•	They occupy the same niche; this is the competitive	
	<u> </u>	1,000,000,000,000	nopac: Paramecium for both	
	lacksquare		ound, pioneer, lichen, adaptations, hostile, less, species, vo	
	A CONTRACT		nsible suggestions, e.g.:	
			ynthesis – so they can produce their own food (light is usu	
			n fixation – the soil, if present, will have low nitrates	
			I reproduction – reproduction still possible with only one i	
			ce of harsh conditions such as wind, lack of water, saline c	
	3.	Any two		
3	.		e the humus and, therefore, the nitrate content of the soil	
			e soil stability by roots	
			e in organic matter in the soil, leading to increased water r	
			s shelter from the wind	
	4.		ary succession does not start with bare ground; it has beer	
	5.		limax occurs as a result of deflected succession. This is cau	
			r / herbicides / excessive wind.	
	1.	$P^2 = the$	frequency of the homozygous dominant genotype	
		$q^2 = the$	frequency of the homozygous recessive genotype	
			he frequency of the heterozygous genotype	
			frequency of the dominant allele	
			frequency of the recessive allele	
	2.		o from: mating is not random, the population is small, ther	
	3.		21 = 0.33	
			<del>33</del> = 0.57	
			0.57 = 0.43	
		$p^2 = 0.1$		
		2pq = 0		
			ted number of heterozygote ladybirds in the population: 1	
	4.		ts a) and b), the student should in vork out p and q as fo	
		$q^2 = 0.4$		
4	$q = \sqrt{0.4} = 0.63$			
		•	0.62 0.3	
			3.63 × 0.37 = 0.4662 = 47 %	
	<b>6</b>		$= 0.37 \times 0.37 = 0.14$	
Take		9	This leads to an increase in the frequency of this allele in	
		7	These individuals are, therefore, more likely to reproduc	
		2	This causes variation within a population	
		5	This leads to competition	
		2	This means the advantageous allele is nassed on to the	



9	This leads to an increase in the frequency of this allele
7	These individuals are, therefore, more likely to reprodu
2	This causes variation within a population
5	This leads to competition
8	This means the advantageous allele is passed on to the
1	Mutations arise within a population, giving new alleles
3/4	The environment applies selection pressures to the popular
6	Individuals with the advantageous allele are more likely
3/4	More individuals are produced than the ecosystem can

#### Task **Answers** number A normal distribution curve / a bell curve The Normal Distribution Cindi ne leacs (mutation and meiosis), and the environment (nutrition) disruptive b) stabilising directional c) A - disruptive A physical barrier separating two populations; for example, a mou 7. Allopatric speciation species, physical, geographically, gene flow, selection pressures. allopatric speciation 9. 1C, 2E, 3B, 4D, 5A 10. The size of the population is dramatically reduced Many gene variants from the original population and The gene pool is now smaller The population is now more susceptible to environment 11. The founder effect is where a portion of the population migrate, being killed by an event as in the population bottleneck. In both 1. Succession 2. Sympatric 3. Selection pressures 4. Many examples – allow any example of a pioneer (examples included) Number of one specific allele for a trait in it is d by the total number Quick Two individuals who can breer to , to luze fertile offspring are me recap 6. 7. Frequency of the half eygous recessive phenotype 8. 9. Intrajas, ir lO. n wing A lot of organisms will fall into either r-strategists or K-strategists, shown below: **Feature K-strategists Body mass** Higher **Extension** Reproductive age Older Number of offspring at one time Few Lifespan Longer Development Slower

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Task number		Answers
	2.	Density-dependent factors are factors where the size of the effect organisms present within the area – the density. These include as availability of mates, number of predators – these all lead to compathogens as these are more easily spread in a high-density populexert their effect irrespective of the density of the population; for natural disasters.
	3.	Succession on a sand dune:
		Pioneer plants such as sea rocket arrive on bare sand
Extension		<ul> <li>These plants are adapted to survive the harsh conditions; se</li> </ul>
cont.		saline environment
		<ul> <li>Pioneer plants change the conditions be less harsh –incresin the sand as the plants rice</li> </ul>
		This allows other ct. is colonise, such as marram grass
		• Marram a shapted to the dry environment, and its roo
		t a veración of a larger dune, and further increases in nu
		d's-foot trefoil can now survive – it is a legume and can, the
		increase the sand nitrate further
E STORY		<ul> <li>This allows sand fescue to grow, which stabilises the sand fu</li> </ul>
		The process continues until a climax community is reached
		succession is no longer happening (on a sand dune this wou

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#### 15. Humans and the planet

Process whereby light is used to create sugars   P   H   O   T   O   S   Process that releases the energy in cells   R   E   S   P   I   R   Involves active management of area   C   O   N   S   E   R   Keeping habitats as they are now   P   R   E   S   E   R   Atom found in all organic molecules   C   A   R   B   O   N   Burning of these releases carbon dioxide   F   O   S   S   I   Term relating to money   E   C   O   N   O   M   The word is CLIMATE    1.   Fossilisation   Carbon dioxide in the atmosphere and in water   Respiration   Photosynthesis   Respiration   Respiration   Respiration   Photosynthesis   Pi   Respiration   Respiration   Photosynthe	Task	ind the planet					
Getting going  Respiration  Carbon dioxide in the atmosphere and in water atmosphere atmosphere and in water atmosphere		Answers					
Involves active management of area		Process whereby light is used to create sugars P H O T O S					
Respiration		Process that releases the energy in cells R E S P I R					
Atom found in all organic molecules  Burning of these releases carbon dioxide  Term relating to money  The word is CLIMATE  1.  Combustion  Carbon dioxide in the atmosphere and in water  Respiration  Photosynthesis  Respiration  Carbon-containing molecules in plants  Feeding  Carling molecules in plants  Feeding  1.  A greenhouse gas is present in Earth's atmosphere. It absorbs readiates it back to Earth. This maintains the temperature of Earth and the service of the composition of the plants. The temperature has increased. There has been a greater rate of 2000. There have been fluctuations within this time frame.  4. The temperature increases, and this will also lead to changes in There will be a change in seasonal growing seasons for plants. The temperature may become too hot for some species and the This will lead to some plant species no longer being able to survious this may lead to extinction of some species, and it might mean sinhabit other areas.  This change in distribution of plant species could lead to a change will lead to a change in distribution of carnivores.  5. No more cows being farmed for food. People enjoy eating beef give this up.  6. Increase in temperature might mean shat the temperature is alwoonly females will may a pop. This would then lead to the end males for the end of the pop. This would then lead to the end males for the end of the pop. This would then lead to the end males for the end of the pop.  Reason  Source of new drugs  Every species has a right to exist Insect species pollinate crop plants  A source of natural predators for pest species  Provide a valuable food source		Involves active management of area CONSER					
Burning of these releases carbon dioxide	Getting						
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Humans have a responsibility to look after other organisms		Provide a valuable food source					
		Humans have a responsibility to look after other organisms					

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**Ecotourism/recreation** 

4. 1C/F, 2A, 3E, 4B, 5C/F, 6D 5. If the temperature changes enough to cause changes to the h particular species, then the conservation efforts to protect the timight mean that mosquitoes would be able to survive in the wetter. This would mean mosquito-borne diseases might been not used to dealing with such health issues.  1. Being able to take a product while not decreasing biodiversity 2. a) 90% b) 34 615 tonnes per year 3. Possible outcomes include: Decrease in polar bears, ringed seals, be seals, harbour seal cod to eat. This might lead to be for each and harp seals we an increase in reliable to be provided as the cod is the code of the seal o	
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	ion, numan
Terai	
Community forest initiatives – gives people the right to exploi	to exploit t
look after it. They are able to get food, building materials and	*
They created forest corridors and devices trategies to counte	o countera
be successful, and this is attributed to he lunning of the sche	300
population is increasing hat this might mean an increase in p	ase in poac
Maac	
4 Came together in conservancies in order to pool their	3000
while also protecting it. They are able to get income from eco	ol their lan
the farming is allowed.	300
However, the landowners are not allowed to graze their stock	300
this leads to an increase in competition for grazing with other 4.	from ecoto eir stock in
Footpaths are well maintained Prevents	from ecoto eir stock in
tne rootp	from ecotou eir stock in ith other far
Drainage ditches are dug across footpaths  To ensure	from ecotor eir stock in ith other far Prevents dar the footpath
erosion	from ecotor eir stock in th other far Prevents dar the footpath To ensure th



Task							
number	Answe	ers					
	Financial incentives for landowners to plant a greater variety of trees	Increase in beincrease in beincrease in bethe therefore, be will lead to be soil too.					
	Farmers are paid to maintain hay meadows and hedgerows	Increase in therefore,					
4 cont.	Blocking drainage ditches on open land (ones made by farmers) with hay bales	Slows down land – decre loss from th					
	Removal of invasive species suc as rhododendron	These would native speci Less grazing					
	Reduce in 9 12 ing by sheep in some areas	overgrazing Prevents da					
E	Seasonal restrictions on walkers and climbers	recreation, presting seas					
	<sup>1</sup> CONS <sup>2</sup> ERVATION C						
Quick recap	3 E C O N O M I 4 C T A O R	5 A Q U					
	G R E E N H O U S E	A C U					
	<sup>7</sup> C I T E S D I O	L T U					
	8 S U S T A I N A B	R L E					
	9 A N T H R O P O G E N I C						
	Challenges include: Increased residential human replace Increased building of in a truth re Introduction of a live species						
Extensio	<ul> <li>Intro pest species</li> <li>2 opest species</li> <li>Habitat destruction and disturbance due to land being used for Over-exploitation of resources</li> </ul>						
	<ul> <li>Management strategies include:</li> <li>Search arriving boats and tourists for foreign species</li> <li>Use of natural predators of pests</li> <li>Culling of larger invasive species such as goats</li> </ul>						
	<ul> <li>The reserve is run by a cooperative between the Na Station, local fishermen and tourist guides</li> <li>No-take zones</li> </ul>	auonai Park Se					

