

# Higher

**GCSE**

**Biology B Twenty First Century Science**

**J257/04: Depth in Biology (Higher Tier)**

General Certificate of Secondary Education

**Mark Scheme for June 2022**

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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**MARKING INSTRUCTIONS****PREPARATION FOR MARKING****RM ASSESSOR**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

**MARKING**

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.

**5. Crossed Out Responses**

Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

**Rubric Error Responses – Optional Questions**

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

**Multiple Choice Question Responses**

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

*When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.*

**Contradictory Responses**

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

**Short Answer Questions** (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

**Short Answer Questions** (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

**Longer Answer Questions** (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. Award No Response (NR) if:
- there is nothing written in the answer space.

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

**The higher mark** should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

**The lower mark** should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

**In summary:**

**The skills and science content determines the level.**

**The communication statement determines the mark within a level.**















Level of response questions on this paper are **1(e)** and **5(b)(iii)**

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## 11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

12. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

<b>Annotation</b>	<b>Meaning</b>
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	Or reverse argument



### 13. Subject-specific Marking Instructions

#### INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

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The breakdown of Assessment Objectives for GCSE (9-1) in Biology B:

	<b>Assessment Objective</b>
<b>AO1</b>	<b>Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.</b>
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
<b>AO2</b>	<b>Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.</b>
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
<b>AO3</b>	<b>Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.</b>
<b>AO3.1</b>	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
<b>AO3.2</b>	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
<b>AO3.3</b>	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

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Question		Answer	Marks	AO element	Guidance
1	(a)	C iris ✓	1	1.1	
	(b)	relay (neuron) ✓ motor (neuron) ✓	2	2.1	<b>ALLOW</b> intermediate / inter (neuron) <b>ALLOW</b> response in either order
	(c) (i)	retina ✓  idea of losing ability to detect light / colour / creating a blind spot <b>OR</b> reference to damage/destruction of rods / cones / (light) receptor cells ✓	2	2.1  1.1	<b>ALLOW</b> macula / rods / cones / (light) receptor cells <b>ALLOW</b> reference to structure E (from diagram) <b>ALLOW</b> idea that they would be blinded  <b>ALLOW</b> receptors
	(ii)	cornea ✓  idea of reduced/lost ability to focus / refract (light) <b>OR</b> blurred vision <b>OR</b> idea of artefacts in vision ✓	2	2.1  1.1	<b>ALLOW</b> reference to structure B (from diagram)  <b>ALLOW</b> infection/inflammation <b>IGNORE</b> refs. to the cornea being damaged/scratched without explanation of how this could affect vision
	(d) (i)	6.5 (mm) ✓	1	2.1	
	(ii)	3 (mm) ✓  no smaller diameter was measured / the pupil was 3 mm in the brightest light <b>OR</b> pupil diameter did not get any smaller as light brightness increased from 70 / 75% to 100% ✓	2	3.2b  3.1a	<b>ALLOW</b> reference to the line being flat / plateaus at 3 mm (from 70/75% light brightness onwards)



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Question			Answer	Marks	AO element	Guidance
1	(d)	(iii)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = -0.004 or <math>-4 \times 10^{-3}</math> (mm/%) award 2 marks</b></p> <p>3.1 – 3.2 <b>OR</b> -0.1 ✓</p> <p><math>\div 25 = -0.004</math> <b>OR</b> <math>-4 \times 10^{-3}</math> (mm/%) ✓</p>	2	1.2	<p><b>ALLOW</b> 3.2 – 3.1 <b>OR</b> 0.1</p> <p><b>IGNORE</b> sign in final answer</p> <p><b>IGNORE</b> fraction of 1/250 as final answer if correct answer given elsewhere</p>

Question	Answer	Marks	AO element	Guidance
1 (e)*	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b> Describes how to change the light brightness to specific levels, and an appropriate way to measure pupil diameter <b>AND</b> Describes a way to increase the accuracy or safety. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b> Describes how to change/measure the light brightness <b>OR</b> an appropriate way to measure pupil diameter <b>AND</b> Describes a way to increase the accuracy or safety. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b> Describes how to change/measure the light brightness <b>OR</b> Describes an appropriate way to measure pupil diameter. <b>OR</b> Describes a way to increase the accuracy or safety. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p><b>0 marks</b> <i>No response or no response worthy of credit.</i></p>	6	3 x 2.2 3 x 3.3a	<p><b>AO2.2 Applying knowledge to describe a method to collect the data in the graph</b></p> <ul style="list-style-type: none"> <li>description of how to change light brightness in a coarse way, e.g. covering windows / closing blinds or curtains / using blackout material / switching ceiling lights on/off / going to different rooms</li> <li>description of how light level could be changed to specific levels/percentages, e.g. using specific numbers of lights/lamps / using precise dimmer / measure light level/intensity using light meter</li> <li>take a photograph of the person's eye in each light level and then measure pupil diameter on photograph</li> </ul> <p><b>OR</b> use a pupillometer to measure pupil diameter for each light level</p> <p><b>AO3.3a Developing procedures that will increase the accuracy or safety</b></p> <ul style="list-style-type: none"> <li>explicit reference to keeping light constant at each level (e.g. <b>not</b> outdoors with varying cloud cover)</li> <li>allow the person's eye to adjust to each light level before measuring, so that their pupil size is staying constant</li> <li>measure the same person each time</li> <li>measure the same eye (left/right) each time</li> <li>don't cast a shadow over the person's eye</li> <li>don't use flash on camera</li> <li>position camera/pupillometer the same distance from eye / same zoom each time</li> <li>include distance marker (e.g. dots on face) in photographs, so pupil diameters can be measured accurately / compared fairly</li> <li>take repeat measurements</li> </ul>

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Question		Answer	Marks	AO element	Guidance
2	(a)	reference to photosynthesis ✓ idea of making its own food / not having to eat / find food ✓	2	2.1	<b>IGNORE</b> references to oxygen <b>ALLOW</b> ides of using glucose produced for respiration
	(b)	(i)	1	2.1	stem cells ✓
		(ii)	4	2.1	<b>Any two from:</b> go through mitosis ✓ (to) divide ✓ (to) make new cells ✓ <b>AND any two from:</b> become differentiated/specialised ✓ switch genes on/off ✓ (to form tissues/organs) with particular functions ✓ <b>ALLOW</b> become any type of cell <b>ALLOW</b> named tissues / organs

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Question		Answer	Marks	AO element	Guidance
3	(a)	<p><b>Any one from:</b></p> <p>environmental/climate change ✓</p> <p>pollution/toxins ✓</p> <p>decreased availability of the penguins' food/prey ✓</p> <p>increased number of the penguins' predators ✓</p> <p>disease/pathogens ✓</p>	1	2.1	<p><b>ALLOW</b> example, e.g. global warming</p> <p><b>ALLOW</b> reason for decreased availability of food e.g. overfishing</p> <p><b>ALLOW</b> hunting / poaching</p>
	(b)	<p>evidence from DNA (analysis) / genome sequencing / genetic testing ✓</p> <p>(showing) differences in the penguins' DNA/genome sequences / genes ✓</p>	2	2.1	<b>ALLOW</b> differences in genotypes
	(c)	nucleus ✓	1	1.1	
	(d)	cell wall / chloroplast(s) ✓	1	1.1	<b>IGNORE</b> vacuole
	(e)	$2 \times 10^{-5} \text{ m}$ ✓	1	1.2	
	(f)	0.000003 m ✓	1	1.2	



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Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 78.5 (mm<sup>2</sup>) award 2 marks</b></p> <p><math>3.14 \times 25 / 3.14 \times 5^2 \checkmark</math>  <math>= 78.5 \text{ (mm}^2\text{)} \checkmark</math></p>	2	1.2	
		(ii)	<p><i>(Antibiotic) C</i> ✓</p> <p><i>Evidence:</i></p> <p>bacteria could not grow in / were killed by antibiotic C ✓</p> <p>the bacteria appear to be resistant to all the other antibiotics ✓</p>	3	3.2a  3.1b x 2	
	(b)	(i)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 8 (%) award 3 marks</b></p> <p><math>17500 - 16200 = 1300 \checkmark</math>  <math>\div 16200 \times 100 = 8.02469136 \checkmark</math></p> <p>= 8 (%) (to 1 sig. fig.) ✓</p>	3	3.1a 1.2 x 2	<b>ALLOW</b> any number from the candidate's working that has been correctly rounded to 1 sig. fig.

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Question			Answer	Marks	AO element	Guidance
4	(b)	(ii)	<p><i>Prediction:</i> any number between 18600-18900 inclusive ✓</p> <p><i>Explanation:</i> idea that the predicted number would fit the trend ✓</p> <p>quantification of the trend, e.g. the number has increased by 1100-1400 each year / the number has increased by 8%-9% each year ✓</p>	3	<p>3.2a</p> <p>3.1b x 2</p>	<b>ALLOW</b> grows at the same rate
	(c)	(i)	<p>loop/ring of DNA/genetic material ✓</p> <p>idea that it is separate from/additional to the bacterial chromosome ✓</p>	2	1.1	
		(ii)	<p>the plasmid carries a gene ✓</p> <p>idea that (it/the gene) affects the phenotype / provides instructions for a new characteristic / is used to make a protein/enzyme (that might work against the antibiotic) ✓</p>	2	1.1	
		(iii)	<p>a mutation ✓</p> <p>(causes) a change in the bacteria's DNA/chromosome/genome sequence/genotype <b>OR</b> creates a new genetic variant ✓</p>	2	1.1	

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Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	iodine (solution) ✓	1	1.2	<b>ALLOW</b> potassium iodide / Lugol('s)
		(ii)	no starch was present/detected/made ✓  photosynthesis had not taken place / because there was no light ✓	2	3.2b	<b>ALLOW</b> sunlight but NOT sun for light
		(iii)	<i>Prediction:</i>  (reagent/iodine will be) blue/black ✓  <i>Explanation:</i>  photosynthesis took place ✓  the plant had (plenty of) light and carbon dioxide ✓	3	2.2	<b>ALLOW</b> reagent/iodine will change colour <b>ALLOW</b> reference to it being "positive" <b>ALLOW</b> starch present  <b>ALLOW</b> "starch present" if not already credited for prediction
		(iv)	stores of starch had been used up / broken down to provide glucose for cellular respiration (during step 1 / during the two days that the plant was in the dark) ✓  the starch was not replaced because photosynthesis had not taken place (during step 1 / during the two days that the plant was in the dark) ✓	2	2.2	
		(v)	so that all three plants had no starch / the same starting point ✓  so that the effects of the foil and the potassium hydroxide could be seen (more) clearly ✓	2	2.2	<b>DO NOT ALLOW</b> "to make it a fair test" without explanation  <b>ALLOW</b> will give clearer results for the tests

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Question			Answer	Marks	AO element	Guidance
5	(a)	(vi)	idea of closing or putting something in the open end of the conical flask ✓  to prevent carbon dioxide entering the flask ✓	2	3.3b	<b>ALLOW</b> example, e.g. cotton wool, bung
	(b)	(i)	E ✓	1	3.1a	
		(ii)	B and C ✓	1	3.1a	

Question			Answer	Marks	AO element	Guidance
5	(b)	(iii)*	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b> Describes the changes in oxygen and carbon dioxide levels before and after point D <b>AND</b> Explains how these are related to light levels, photosynthesis, and respiration. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b> Describes the changes in oxygen and carbon dioxide levels <b>AND</b> Explains how these are related to light levels and photosynthesis. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b> Describes oxygen and carbon dioxide levels. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p><b>0 marks</b> <i>No response or no response worthy of credit.</i></p>	6	3 x 3.1b 3 x 2.1	<p><b>AO3.1b Describing evidence on the graph to support the student's conclusion</b></p> <p><b>AO2.1 Explaining, by applying scientific understanding, how the changes in oxygen and carbon dioxide concentration could have resulted from changes in light levels</b></p> <p>For example: <i>Before time point D:</i></p> <ul style="list-style-type: none"> <li>• [AO3.1b] oxygen level was increasing</li> <li>• [AO3.1b] carbon dioxide level was decreasing</li> <li>• [AO2.1] because it was light so photosynthesis was taking place in the pondweed</li> <li>• [AO2.1] photosynthesis was producing oxygen and using up carbon dioxide (at a faster rate than respiration was doing the reverse)</li> <li>• [AO3.1b] there was a change/slowing of the rate between time points C and D</li> <li>• [AO2.1] because the sun was setting/light was fading, so rate of photosynthesis gradually decreased</li> </ul> <p><i>After time point D:</i></p> <ul style="list-style-type: none"> <li>• [AO3.1b] oxygen level decreased</li> <li>• [AO3.1b] carbon dioxide level increased</li> <li>• [AO2.1] because it was dark so no photosynthesis to produce oxygen or use up carbon dioxide</li> <li>• [AO2.1] while it was dark respiration was using up oxygen and producing carbon dioxide</li> </ul>

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Question		Answer	Marks	AO element	Guidance
6	(a)	only water molecules can diffuse through the membrane ✓	1	1.1	
	(b)	<b>Any three from:</b>  reference to osmosis (through/across the cell membrane) ✓  idea that the movement/process is passive / does not require ATP/active transport/additional energy ✓  idea of difference in concentration / initially more water molecules outside and fewer inside the cell ✓  idea that net movement is into the cell/cytoplasm ✓	3	1.1	<b>ALLOW</b> movement down a concentration gradient <b>DO NOT ALLOW</b> along a concentration gradient
	(c)	reference to active transport (through/across the cell membrane) ✓  requires ATP/additional energy ✓  provided by mitochondria in the root hair cell ✓	3	1.1	
	(d)	larger surface area (to volume ratio) ✓  (more area/membrane) means more osmosis/active transport can occur ✓	2	1.1	Answer must be comparative

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Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	<p><b>Any two from:</b></p> <p>tested on animals ✓</p> <p>tested on cultured (human) cells ✓</p> <p>tested using computer modelling ✓</p> <p>idea of (in vitro/biochemical) testing/screening to see if the vaccine reacts with its target (human immune cell receptors) ✓</p>	2	2.1	
		(ii)	<p>(tested in group 1) to check for safety / side-effects / adverse reactions ✓</p> <p>(not tested in group 2 only tested in group 1 because) a vaccine is given to prevent not cure a disease ✓</p> <p>to test how well the vaccine can protect somebody from later getting the disease / how well it establishes immunity ✓</p>	3	2.1	
	(b)	(i)	<p>reference to ribosome(s) ✓</p> <p>reference to joining amino acids together ✓</p> <p>in the correct order / according to the instructions/sequence in the mRNA ✓</p>	3	2.1	

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Question			Answer	Marks	AO element	Guidance
7	(b)	(ii)	<p><b>Any four from:</b></p> <p>reference to white blood cells ✓</p> <p>the influenza protein sticks to/is detected by receptors (on white blood cells / immune cells) ✓</p> <p>the protein is recognised as non-self/foreign / is recognised as an antigen / is recognised as coming from a virus/pathogen ✓</p> <p>antibodies are made (to destroy the protein) ✓</p> <p>reference to memory cells (being formed) ✓</p> <p>reference to (memory cells) conferring immunity / (memory cells) responding more quickly if the protein/influenza/antigen/virus is encountered again ✓</p>	4	2.1	



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