2019 VCE Biology examination report

General comments

The 2019 Biology examination was the third examination for the *VCE Biology Study Design 2017–2021* and students were clearly familiar with the expectation of writing within designated spaces on the pages of the examination. In Section B students must follow the written instruction to use blue or black pen to ensure legibility. This was particularly important as the students' examinations were once again scanned and assessed online.

Students showed an increased familiarity with the knowledge and skills they had gained from Unit 4, Area of Study 3. Responses to Question 11 demonstrated that students were generally able to identify where errors had occurred in experiments. Students were less confident in their identification of the type of errors that can occur. Students are reminded that the set of key science skills (refer to pages 10 and 11 of the Study Design) are examinable and school-assessed coursework provides students with firsthand experience that can be applied to examination questions.

Some questions required more thought and application. It is important students recognise that prepared answers are very unlikely to earn them full marks for this type of response. Students need to consider the situation described and adapt their answer accordingly, for example in Question 7c.

Students generally made appropriate use of the data and information provided in diagrams such as in Question 2ai. However, students should be aware that extended responses require them to apply this knowledge and develop more considered and complex answers based on the information provided. The number of marks allocated and the answer space provided gives students a guide as to the required depth of the answer.

A logical approach is strongly recommended when answering questions worth more than two marks. If a question asked for a specific answer and a justification, the students who gave a clear answer to the question followed by the justification were more likely to receive full marks. Students should avoid restating the stem of the question and ensure they discuss, rather than list, if asked to discuss. Students were aware of the need for comparative answers, although more detail of the two factors being compared was generally needed.

While spelling is not directly assessed, if a word has multiple possible meanings or a word is not identifiable, then the student will not receive the mark, such as in Question 1a. Students correctly used suitable abbreviations such as DNA, ATP and NADH and avoided abbreviating other terms. Students used chemical symbols such as H_2O and CO_2 correctly in Question 2a.; however, spelled-out words were equally acceptable.

Section A – Multiple-choice questions

The table below indicates the percentage of students who chose each alternative. The correct answer is indicated by shading.

Question	% A	% B	% C	% D	Comments
1	3	2	90	5	
2	10	87	1	2	
3	11	74	5	10	
4	10	11	17	62	
5	89	3	3	5	
6	5	26	8	60	
7	1	1	1	98	
8	5	11	6	78	
9	95	3	2	1	
10	4	8	6	81	
11	59	8	19	14	
12	15	74	11	0	
13	2	85	10	3	
14	71	13	11	5	
15	12	5	71	11	
16	7	4	24	65	
17	6	2	89	2	
18	5	90	2	3	
19	6	4	5	86	
20	69	14	6	12	
21	3	4	92	1	
22	12	80	2	5	
23	4	82	10	3	
24	6	17	74	2	
25	4	13	2	81	
26	3	5	57	35	
27	1	4	94	1	
28	1	3	76	19	
29	6	4	6	85	
30	13	73	6	8	
31	71	12	14	3	
32	7	46	9	37	The inferred average brain size, based on the cranial capacity, is smaller in more ancient hominin genera *Australopithecus* and larger in more modern *Homo* species. *Homo floresiensis* does not fit the trend as it has the smallest inferred average brain size.
33	6	18	6	70	
34	8	33	37	22	Antibiotics such as penicillin act against bacteria by inhibiting cell wall synthesis. The bacteriophage as stated in the question ruptures the membrane, which will release more of the bacteriophages the bacterial cell has been programmed to produce.
35	7	81	1	10	
36	73	2	18	6	
37	4	19	74	2	
38	82	11	4	3	
39	13	17	58	12	
40	52	4	3	41	Mammals all have hair. Hominoids, humans and their fossil ancestors the anthropoid apes lack tails.

Section B

The majority of students found the space allocated to answer Section B adequate. Students are strongly advised to read the question carefully and formulate their answer before writing it. Some students wasted space by including the stem of the question in their response. Others appeared to use the space to formulate an answer that then changed with further thought. Students generally used pen to answer this section but used pencil, as previously advised, to answer parts of limited space or in tables such as Question 1a. and Question 6c.

Most scripts had answers provided to every part and little extraneous material. This indicated that the examination was accessible and that students had the confidence to attempt responses.

Question 1a.

Marks	0	1	2	Average
%	57	25	18	0.6

	Molecule 1	Molecule 2
Difference 1	Uracil	Thymine
Difference 2	ribose sugar	deoxyribose sugar
Difference 3	More oxygen	Less oxygen

Thiamine was not acceptable as this is a type of Vitamin B.

Question 1b.

Marks	0	1	2	Average
%	57	32	11	0.6

- Many monomers make up introns, which do not code for amino acids
- Each amino acid is coded for by three monomers.

Question 2ai.

Marks	0	1	Average
%	31	69	0.7

Water and carbon dioxide (chemical symbols equally acceptable).

Question 2aii.

Marks	0	1	2	Average
%	45	31	24	0.8

- Water is split in the light-dependent reaction to produce oxygen gas.
- Oxygen produced diffuses into the stroma (region R) **or** When light is not available, oxygen is not produced.

Question 2b.

Marks	0	1	2	Average
%	16	40	44	**1.3**

- NADPH transfers hydrogen ions. Protons and electrons was also an acceptable answer.
- ATP transfers energy.

To gain full marks students were required to give the role of each coenzyme.

Question 3a.

Marks	0	1	2	Average
%	11	27	62	**1.5**

Examples of possible routes included:

- a cut in the skin
- respiratory surfaces
- the digestive system
- the reproductive system
- eyes.

Question 3b.

Marks	0	1	2	Average
%	50	8	42	**0.9**

Suitable examples of chemical barriers and their function included:

- stomach acid, which breaks down bacteria
- lysozymes in tears, which break down bacteria
- complement proteins, which attract immune cells or stimulate phagocytes to become more active by coating their surface and binding.

Some students confused lysosomes with lysozymes.

Question 3c.

Marks	0	1	Average
%	46	54	**0.6**

Suitable responses included:

- vasodilation, or a description of vasodilation
- by increasing the permeability of blood vessels.

Question 3d.

Marks	0	1	2	Average
%	53	20	27	**0.8**

Antigen-presenting cells display the antigen on their cell surface to helper T lymphocytes/helper T-cells.

Students needed to describe the initiation of the adaptive immune response by bacterial infection. Responses discussing cytotoxic T-cells were therefore incorrect.

Question 4a.

Marks	0	1	2	Average
%	33	35	32	1

The cells are mast cells and the proteins are IgE antibodies.

Question 4b.

Marks	0	1	2	Average
%	5	19	75	1.7

Possible strategies included:

- avoid going outside when threat is reported
- take antihistamines (or asthma medication)
- wear a face mask.

Question 4c.

Marks	0	1	2	Average
%	54	41	5	0.5

This would not be possible as many allergens contribute to the allergic response to the pollen fragments rather than a single pathogen. A vaccine would lead to greater production of antibodies, which would in turn increase the response.

Students could also present the case of allergen immunotherapy in which the regular administration of gradually increasing doses of allergen extracts over a period reduces the immune system reaction, switching off the allergic reaction to the pollen fragments.

Question 5a.

Marks	0	1	Average
%	9	91	0.9

The beak shape would be deep and long.

Question 5b.

Marks	0	1	2	Average
%	33	42	26	1

Beak length is controlled by the gene CaM **or** is not controlled by the BMP4 gene. Therefore, the beak length is unaffected **or** remains long.

Beak depth would be shallow as BMP4 expression is inhibited.

Students were required to address both the length and the depth of the beak and provide a reason for each.

Question 5c.

Marks	0	1	2	3	Average
%	41	40	10	9	**0.9**

BMP4 is a master gene and its expression controls many genes (and therefore many traits).

- Altering the expression of the BMP gene may produce a gene that is a selective advantage
- Finches with the new advantageous phenotype would survive, reproduce and pass this trait on to their offspring.

Some students did not understand the function of a master gene and wrote prepared responses relating to natural selection.

Question 6ai.

Marks	0	1	Average
%	59	41	**0.4**

Aneuploidy is an abnormal number of chromosomes.

Answers could also acknowledge that it could involve more or fewer chromosomes.

Question 6aii.

Marks	0	1	Average
%	87	13	**0.2**

The sample would contain fetal DNA or chromosomes (which could be analysed).

The most common incorrect responses referred to the mother's DNA or chromosomes, or did not distinguish whether it was the mother's or fetal chromosomes that would be examined.

Question 6b.

Marks	0	1	2	Average
%	43	15	42	**1**

Suitable descriptions of types of block mutations included:

- duplications where part of a chromosome is copied
- where part of a chromosome is deleted or moved to another position on a chromosome.

Other suitable descriptions of inversions and additions were also acceptable.

Some responses referred to a single nucleotide being involved rather than a section of a chromosome or many bases. Another incorrect response referred to the deletion of amino acids, which is the result of a block mutation.

Question 6c.

Marks	0	1	2	Average
%	10	12	78	**1.7**

Translated sequence: met-val-his-leu-thr-pro-glu-glu

Question 6di.

Marks	0	1	Average
%	35	65	0.7

Glu in the 7th codon position has been replaced by val.

Question 6dii.

Marks	0	1	2	Average
%	24	44	32	1.1

A frameshift would result (in which all amino acids from this point would change).

This could result in non-functional haemoglobin being produced as the shape may have changed.

Question 7a.

Marks	0	1	2	Average
%	18	27	55	1.4

The type of evolution is divergent evolution. The three species were exposed to different selection pressures.

Question 7b.

Marks	0	1	Average
%	52	48	0.5

Possible causes for extinction include:

- ice age or cold environment
- hunting by humans
- habitat destruction
- disease
- lack of genetic diversity.

Some students referred only to a change in climate, but reference to an increase or decrease in climate temperature was required.

Question 7c.

Marks	0	1	2	3	4	Average
%	20	28	27	18	7	1.7

Three of the following:

- body is not eaten by scavengers
- body is frozen and does not decay
- there is a lack of oxygen
- uplift, erosion or melting of the glacier exposes the remains.

Students were also required to recognise that the steppe bison was frozen **or** was rapidly buried. Answers that referred to the bison being covered in rock were incorrect.

Question 8a.

Marks	0	1	Average
%	18	82	0.8

Suitable examples of a disorder or disease included:

- cystic fibrosis
- PKU
- albinism
- Down syndrome
- Sickle cell anaemia.

The disorder or disease did not have to be one that is caused by the type of mutation described in the source information, as this was not specified.

Question 8b.

Marks	0	1	2	3	Average
%	19	12	19	51	2

A high-scoring response included the following information.

Stage	Description of what is happening at this stage
1	Heat DNA to approximately 90 °C
2	Cool to anneal or attach primers
3	Taq polymerase copies strands

Students generally answered this question well. However, some students gave contradictory information in the description of each stage. The names of the stages were not required.

Question 8c.

Marks	0	1	2	3	Average
%	30	30	31	9	1.2

Suitable responses for factors affecting the migration of DNA fragments through the agarose gel during gel electrophoresis included three of the following:

- the size of the molecules, as the larger molecule will move more slowly
- the charge of the molecule, as the negative charge means that DNA moves towards the positive electrode
- the length of time the voltage is applied, as there may not be enough time for the DNA to migrate through the gel
- the concentration of the agarose, as denser agarose results in the molecules moving more slowly.

Students needed to discuss each factor rather than just list them.

Question 8d.

Marks	0	1	2	Average
%	26	54	20	1

	Issue/Implication
Ethical	Reasonable suggestions included: • Possible termination decisions of foetus. • Should a severely affected child who may suffer be born? • Should alternative reproductive technologies be accessed?
Social	Reasonable suggestions included: • Cost to society of alternative reproductive approaches (e.g. IVF). • Psychological implications for the parents, knowing they are carrying the mutation. • Societal support required: could the government's money be better spent elsewhere?

Students were more accurate in their identification of an ethical issue or implication than the social issue or implication. Writing the implication or issue as a question often resulted in a clearer response. In formulating a social issue or implication, students can be guided by checking whether the answer they have written relates to society and impacts more than one or two individuals. Students were required to recognise that the foetus is not being tested, only the parents. Therefore, it could not be assumed a child of the parents would have the disorder.

Question 9a.

Marks	0	1	Average
%	64	36	0.4

Factors that could lead to transfer between hosts include:

• increased population coming into contact with wild animal habitat
• urbanisation of habitats in proximity to wild animals increases the chance of direct transfer
• transportation of wild animals
• lack of education about transmission of disease.

Transmission is not via food or water.

Question 9b.

Marks	0	1	2	3	Average
%	30	42	23	5	1.1

Specific pathogens have specific methods of transfer. They may require specific methods of control such as a particular antiviral drug. Incorrect identification can lead to continued infections and spread.

or

Identify pathogen and isolate antigens. This would enable the production of a vaccine or produce a drug with a complementary shape. If the majority of the population was vaccinated or treated with this rational drug, this would greatly reduce the transmission of the disease.

Question 9c.

Marks	0	1	2	Average
%	56	33	10	0.6

The shape of the Zika and other viruses' antigen is similar, enabling them both to bind on to the same antibody.

The viruses bind to the antigen-binding site of the antibody.

Question 9d.

Marks	0	1	2	3	Average
%	8	25	42	25	1.9

Three different approaches could include:

- inspect and fumigate cargo entering new countries
- quarantine of people who come from countries in which the disease occurs
- control mosquito breeding places, use of mosquito nets or fly screens on windows
- education campaign about suitable clothing, use of insect repellent.

Question 10a.

Marks	0	1	2	Average
%	84	16	1	0.2

It would not be possible to classify the Denisovans as a separate group from Neanderthals as the fossil sample is too small.

As both groups are extinct, one is unable to determine if fertile offspring could be produced.

Question 10b.

Marks	0	1	2	Average
%	66	25	9	0.5

Mitochondrial DNA is only inherited from the mother (and would therefore provide very similar DNA samples to other female ancestors); however, nuclear DNA contains the whole genome.

Question 10c.

Marks	0	1	2	3	Average
%	12	20	53	15	1.7

Site 1 Africa	*H. sapiens* and/or *H. heidelbergensis*	No fossil evidence of the other two Homo species in Africa, and modern Africans do not have Neanderthal or Denisovan DNA **or**

		They didn't leave Africa until 60 000 years ago, so still present
Site 2 Asia and PNG	Denisovans	Modern Asian and Pacific Islanders have 3–5 per cent Denisovan DNA
Site 3 Europe	Neanderthals	Most humans with European ancestry have 1–3 per cent Neanderthal DNA

Question 11a.

Marks	0	1	2	Average
%	14	42	45	1.3

35 °C is the temperature at which the measurements are the most precise, as there is the least variation between trials.

Students were required to give a comparative answer.

Question 11b.

Marks	0	1	2	Average
%	29	43	28	1

Data is quantitative as it is expressed numerically. Qualitative data is descriptive.

Some students defined qualitative data using examples only. This was not enough to gain the mark. No mark was awarded for 'quantitative' without explanation.

Question 11c.

Marks	0	1	2	3	Average
%	13	32	36	19	1.6

Measurement 2 at 15 °C and measurement 3 at 25 °C have errors.

Examples of sources of error could be any two of the following:

- adding a larger volume of lipase solution to the test tube
- adding less sodium carbonate to the test tube
- incorrectly measuring the volume of fatty acid solution
- incorrect measurement of pH
- recording the time incorrectly.

Question 11d.

Marks	0	1	2	Average
%	60	23	17	0.6

The type of error was a systematic error.

Suitable sources of error included:

- the pH meter may not have been correctly calibrated
- the students are consistently using a measuring cylinder incorrectly to measure the volume of lipase solution.

While some students were able to identify the error type, fewer were able to identify the source of error.

Question 11e.

Marks	0	1	2	Average
%	64	18	18	0.6

Suitable limitations and what the student could do to address the limitation included:

- The temperature was only measured up to 35 °C, which is a limited temperature range. A wider range of temperatures should be used.
- No control was used. A sample without lipase should be used.