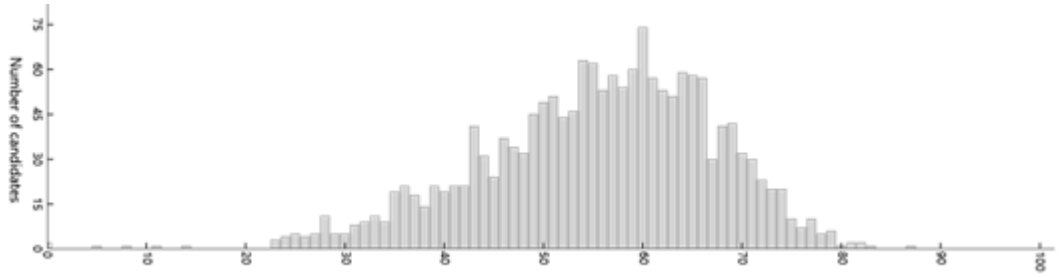
2021 ATAR course examination report: Biology

Year	Number who sat	Number of absentees
2021	1716	29
2020	1758	23
2019	1769	21
2018	1835	29

The number of candidates sitting and the number attempting each section of the examination can differ as a result of non-attempts across sections of the examination.

Examination score distribution–Written



Summary

The examination paper had three sections. Section One comprised 30 Multiple-choice questions, Section Two comprised five Short answer questions and Section Three comprised two Extended answer questions from Unit 3 and two from Unit 4. Candidates were required to answer all questions in Sections One and Two, and one question from each of Units 3 and 4 in Section Three. The examination was attempted by 1716 candidates and had a mean score of 55.25%. Scores ranged from a maximum of 86.75% to a minimum of 0%.

Attempted by 1716 candidates	Mean 55.25%	Max 86.75%	Min 0.00%
Section means were:			
Section One: Multiple-choice	Mean 77.82%		
Attempted by 1716 candidates	Mean 23.35(/30)	Max 30.00	Min 0.00
Section Two: Short answer	Mean 50.01%		
Attempted by 1712 candidates	Mean 25.01(/50)	Max 43.00	Min 0.00
Section Three: Extended answer Unit 3	Mean 36.20%		
Attempted by 1696 candidates	Mean 3.62(/10)	Max 9.00	Min 0.00
Section Three: Extended answer Unit 4	Mean 32.80%		
Attempted by 1694 candidates	Mean 3.28(/10)	Max 7.75	Min 0.00

General comments

Candidates were generally well prepared, and most candidates attempted all questions.

The overall mean score was very similar to that in the 2019 (54.64%) and 2020 (54.86%) examinations. The mean score for Section One was higher with 77.82%, Section Two was

moderate at 50.01%, while the means for Section Three Units 3 and 4 were lower at 36.20% and 32.80%, respectively.

Advice for candidates

- Use formal and precise language and scientific terminology when answering questions.
- Communicate clearly in your written answers.
- Carefully label diagrams. Lines should point exactly to the structure being labelled.
- Read the question carefully and make sure that you answer the question asked. Be alert to subtle components that require attention.
- Be prepared to apply your knowledge and understanding of topics in a range of contexts.
- Develop an in-depth knowledge of key topics and concepts so that you can provide full responses to short answer and extended answer questions.
- Spend some time planning your responses to extended answer questions so that you do not miss crucial details and/or repeat points.

Advice for teachers

- Prepare students to answer questions from across the syllabus.
- Help prepare students to apply their knowledge and understanding of topics in a range of contexts by providing a broad range of sample questions.
- Instruct students how to answer questions according to the 'command' verb in the question e.g. state, define, explain, compare, discuss. For example, 'compare' answers should include a systematic evaluation of similarities and differences. 'Discuss' answers should identify issues and provide points for and/or against.
- Give students practise at decoding questions so as to recognise subtle components of questions that require attention.

Comments on specific sections and questions

Candidates typically answered the multiple-choice questions very well but had more difficulty with the short answer, and especially the extended answer questions. On average, candidates performed well in constructing a graph and with factual recall and data interpretation questions. In the Extended answer section, candidates struggled with questions that required them to apply their knowledge, provide in-depth explanations or discuss a topic.

Section One: Multiple-choice (30 Marks)

Candidates performed very well in this section with a mean score of 77.82%. All candidates attempted every question. The maximum score for this section was 100% and the minimum score was zero. No single question was answered correctly by every candidate.

Six questions (8, 9, 13, 16, 18 and 24) had mean scores of 90% or above. Most of these questions tested factual recall from content in Unit 4. No question had a mean score below 50%. Questions 25 and 22 had the lowest mean scores at 52% and 59%, respectively. Question 25 required candidates to identify that an endotherm uses a higher percentage of its energy to maintain homeostasis than an ectotherm. Question 22 required candidates to deduce phenotypic ratios from a parental cross.

Question 1 attempted by 1716 candidates	Mean 0.87(/1)	Max 1	Min 0
Question 2 attempted by 1716 candidates	Mean 0.81(/1)	Max 1	Min 0

Question 3 attempted by 1716 candidates	Mean 0.77(/1)	Max 1	Min 0
Question 4 attempted by 1716 candidates	Mean 0.75(/1)	Max 1	Min 0
Question 5 attempted by 1716 candidates	Mean 0.87(/1)	Max 1	Min 0
Question 6 attempted by 1716 candidates	Mean 0.88(/1)	Max 1	Min 0
Question 7 attempted by 1716 candidates	Mean 0.69(/1)	Max 1	Min 0
Question 8 attempted by 1716 candidates	Mean 0.93(/1)	Max 1	Min 0
Question 9 attempted by 1716 candidates	Mean 0.97(/1)	Max 1	Min 0
Question 10 attempted by 1716 candidates	Mean 0.86(/1)	Max 1	Min 0
Question 11 attempted by 1716 candidates	Mean 0.78(/1)	Max 1	Min 0
Question 12 attempted by 1716 candidates	Mean 0.79(/1)	Max 1	Min 0
Question 13 attempted by 1716 candidates	Mean 0.92(/1)	Max 1	Min 0
Question 14 attempted by 1716 candidates	Mean 0.87(/1)	Max 1	Min 0
Question 15 attempted by 1716 candidates	Mean 0.89(/1)	Max 1	Min 0
Question 16 attempted by 1716 candidates	Mean 0.90(/1)	Max 1	Min 0
Question 17 attempted by 1716 candidates	Mean 0.86(/1)	Max 1	Min 0
Question 18 attempted by 1716 candidates	Mean 0.91(/1)	Max 1	Min 0
Question 19 attempted by 1716 candidates	Mean 0.61(/1)	Max 1	Min 0
Question 20 attempted by 1716 candidates	Mean 0.63(/1)	Max 1	Min 0
Question 21 attempted by 1716 candidates	Mean 0.72(/1)	Max 1	Min 0
Question 22 attempted by 1716 candidates	Mean 0.59(/1)	Max 1	Min 0
Question 23 attempted by 1716 candidates	Mean 0.71(/1)	Max 1	Min 0
Question 24 attempted by 1716 candidates	Mean 0.91(/1)	Max 1	Min 0
Question 25 attempted by 1716 candidates	Mean 0.52(/1)	Max 1	Min 0
Question 26 attempted by 1716 candidates	Mean 0.69(/1)	Max 1	Min 0
Question 27 attempted by 1716 candidates	Mean 0.63(/1)	Max 1	Min 0
Question 28 attempted by 1716 candidates	Mean 0.62(/1)	Max 1	Min 0

Question 29 attempted by 1716 candidates Mean 0.73(/1) Max 1 Min 0

Question 30 attempted by 1716 candidates Mean 0.67(/1) Max 1 Min 0

Section Two: Short answer (100 Marks)
This section was attempted by almost all candidates. The mean score was 50.01% and the mean score per question ranged from 59.15% (Question 33) to 39.4% (Question 32). The maximum score for this section was 86%, however the maximum scores for individual questions were higher.

Question 31 attempted by 1712 candidates Mean 10.91(/21) Max 19.5 Min 0
This question covered topics in the Continuity of life on Earth area of the syllabus. The mean score was 51.95%. Candidates generally did very well in parts (c)(i) to (c)(iv), which required them to interpret and read data from a figure. The mean score for part (a), which required candidates to name the four factors that change allele frequencies in populations, was also satisfactory, although most candidates were unable to identify all four factors. The mean scores for parts (b), (d) and (e) were below 50%. Part (b) asked candidates to explain how the range of variation in domestic dogs had arisen. A seemingly straightforward explanation of how this had happened via artificial selection was required but many candidates did not provide the required level of detail. They missed the opportunity to state that some dogs were bred for different purposes, resulting in a variety of breeds with different traits. Part (d) asked candidates to explain the type of evidence that would have been used to determine the number of species in Canidae groups over evolutionary time. A straightforward explanation of the main steps involved in determining this data from fossil evidence was required, however, many candidates gave only general and/or brief answers regarding fossil evidence. Some candidates also included distractions like DNA evidence/comparative genomics.

Question 32 attempted by 1709 candidates Mean 7.88(/20) Max 17.5 Min 0
This question covered topics in the Homeostasis area of the syllabus. The mean score for this question was only 39.4%. Candidates generally performed well in part (a)(i), which required them to state that ‘xerophyte’ is the term used to describe plants adapted to arid environments, and in part (a)(ii), which required them to describe how plants lose water to the environment. For part (b), most candidates were able to recognise that Plant A occurred in an arid environment based on the leaf cross-section. However, few correctly labelled the features that indicated this. Many candidates were able to name relevant features but did not unambiguously label the features in the diagram and often the line labels only pointed in the general vicinity of the feature. Part (c), which required candidates to explain how the ability of seeds to germinate after many years in the soil might be an advantage to plants that live in arid environments, had a very low mean score of 20.75%. Very few recognised that this allowed for plants to survive when water was not available and to grow at times when water was available. Part (e) asked candidates to explain the challenges that a fish faces in maintaining salt-water balance in salt lakes. Many candidates stated the challenges, but rather than explaining these they explained the mechanisms used to maintain salt-water balance.

Question 33 attempted by 1709 candidates Mean 11.24(/19) Max 17.5 Min 0
This question covered topics in the Science Inquiry Skills and Heredity areas of the syllabus. The mean score for this question was 59.15%. Candidates generally performed very well in parts (a) and (c), which required candidates to interpret data from the table. Most candidates were also able to correctly draw a bar graph and label the axes, however some did not

include spaces between the bars and/or include a title. Overall, candidates performed less well in other parts of this question, especially part (d) and part (f). For part (d), some candidates did not recognise that fewer tanks had been sampled, whilst others recognised this but struggled to provide the required level of detail in their answer to achieve full marks. Some contradicted themselves by initially saying that the conclusion was valid and later suggesting that it was not. Part (f) was seemingly a straightforward question that asked candidates to outline the four main steps required to produce a line of transgenic fish. Many candidates provided a lot of specific detail about the methods used to create genetically modified organisms at the expense of focusing their answer on the four main steps – 'identify', 'isolate', 'insert' and 'verify'.

Question 34 attempted by 1710 candidates Mean 11.53(/20) Max 20 Min 0
This question covered topics in the Infectious diseases and Heredity areas of the syllabus. The mean score for this question was 57.65%. Candidates were generally able to identify one or two of the main structural features of a virus in part (a)(i), but many struggled to list two characteristics that suggest a virus is not a living organism in part (a)(ii). Some candidates gave the characteristics of prokaryote cells rather than identifying that virus' are non-cellular and require a host cell to reproduce. In part (b)(i) most candidates were able to identify that deformed wing in honeybees is an infectious disease and many were able to explain why. However, they struggled to state the defining features of a disease vector. More capable candidates gave examples of vectors to strengthen their answer. Overall, candidates did very well in part (d) with a mean score of 80.67%, recognising that the number of amino acids in the protein could be calculated by dividing the number of nucleotides by 3. Part (e) required candidates to use the information provided to determine the number of chromosomes in a male honeybee and this was generally well done, although many candidates were unable to step their answer out properly to earn full marks.

Question 35 attempted by 1707 candidates Mean 8.45(/20) Max 18.5 Min 0
This question covered topics in several areas of the syllabus and mainly had a conservation theme. The mean score was 42.25%. In part (a), candidates generally gave good advice about how to detect crown gall in garden plants, although some descriptions of the symptoms of the disease were too general or vague, e.g. wilting plants. Many candidates failed to recognise that part (b) was asking about plant conservation strategies and focused their answer on how to prevent the spread of crown gall/disease, presumably following on from part (a). Candidates performed best in part (c), which required them to draw a phylogenetic tree. Most struggled with part (e), which required them to explain bioinformatics and why it is important to comparative genomics. Most candidates did not seem to fully understand the meaning of the term bioinformatics, or that it is needed to analyse the very large data sets generated by comparative genomics. A few candidates, however, answered the question very well.

Section Three: Extended answer Unit 3 (20 Marks)
Most candidates attempted this section. The mean score was low at 36.20%. Slightly more than half (55.60%) of the candidates answered Question 37, which had a higher mean score (41.75% versus 29.4%) and a higher maximum mark (90% versus 75%) than Question 36.

Question 36 attempted by 753 candidates Mean 5.88(/20) Max 15 Min 0
The mean scores for parts (a) and (b) were very low at 27.5% and 41%, respectively. No candidates achieved full marks in either part (a) or part (b).

Part (a) asked candidates to outline the four main steps involved in gene expression and to explain how, using examples, the phenotypic expression of a gene can depend on interactions with the environment. Candidates struggled to interpret this question. Those who identified that 'gene expression' equated to 'protein synthesis' were able to identify the main steps, although they often wrote a large amount of detail for the marks that were available. On the other hand, candidates generally only briefly mentioned how the environment can influence the phenotypic expression of genes. Candidates are advised to ensure that they fully answer all components of the question asked and to use the command verb (e.g. outline versus explain) as a guide to the amount and type of information required for each component.

Part (b) required candidates to explain how sexual selection is similar to, and differs from, natural selection. Many candidates did not spend time explaining the process of sexual selection and very few candidates included details about males competing against each other for mates in their answer. Most candidates did not provide a sufficient level of detail in their answer to be able to explain the similarities and differences between sexual and natural selection. Some used tables to compare the two processes but failed to use matching points to demonstrate the extent of their understanding. Other candidates only briefly mentioned some similarities and differences and then spent a considerable amount of time describing an example of a specific trait that evolved by sexual selection, which was not the main emphasis of the question.

Question 37 attempted by 943 candidates Mean 8.35(/20) Max 18 Min 0
The mean scores for parts (a) and (b) were similar at 41.5% and 42% respectively. At least one candidate achieved full marks in each part.

Part (a) asked candidates to use the data provided, and their knowledge of microevolutionary forces, to explain how soapberry bugs feeding on the fruit of introduced golden rain tree with small fruit came to have smaller beaks than those feeding on the native balloon vine with large fruit. Many candidates constructed their answer in the reverse (why the beak lengths are larger for the balloon vine fruit), and candidates are reminded to carefully follow the instructions given in the question. Many candidates became distracted by irrelevant details such as what the fruit and seeds look like, and the relative size of the bug, and this uncertainty was apparent in their responses. Many candidates seemed to be overwhelmed with the details for what was intended as a straightforward question where candidates could apply their skills in data interpretation and knowledge of natural selection.

Part (b) asked candidates to explain, using examples, how chemical factors in the environment can cause mutations and also discuss the consequences of a mutation occurring in a germline cell and a somatic cell. Many candidates provided a good level of detail in their responses to this question. Most were able to differentiate between 'germ-line' and 'somatic' cells and provide some level of detail regarding the consequences of a mutation occurring in these cells. The most common error was that many gave physical radiation (X-rays, nuclear and radioactive waste) as their example of a chemical mutagen. Many wrote in general terms about the DNA or chromosomes being affected rather than providing specific details about how the DNA or chromosomes are affected. Some spent considerable time providing examples, which were only worth a total of two marks. Many also gave superfluous detail about the different type of mutations that can occur – point, substitution, insertion, deletion, frameshift etc.

Section Three: Extended answer Unit 4 (20 Marks)
Most candidates attempted this section, although the mean score was low at 32.80%. Approximately two thirds of the candidates answered Question 38, which had a lower mean score (28.1% versus 42.25%) and a lower maximum mark (70% versus 77.5%) than Question 39.

Question 38 attempted by 1126 candidates Mean 5.62(/20) Max 14 Min 0
The mean scores for parts (a) and (b) were very low, especially for part (b). No candidate achieved full marks in either part (a) or part (b).

Part (a) described three features of whales and asked candidates to explain how each of these features help whales to thermoregulate in cold water. Many candidates were able to provide sound responses around the three main points – small surface area to ratio, reduced core temperature and thick layers of blubber – but were not always able to fully explain each factor. A common error was stating that the large body size of whales would give the organism a large surface area to volume ratio (rather than the reverse). Another common error was stating that a lower core temperature would result in less energy being required to maintain homeostasis, rather than appreciating that a lower temperature gradient will reduce the rate at which heat is lost. Very few candidates provided the general point about the whale losing heat to the environment and this contributed to no candidate achieving full marks.

Part (b) required candidates to discuss the effects of global climate change on the distribution of human diseases by direct and indirect transmission. Most candidates struggled with this question. Candidates were generally able to identify that indirect transmission involves vectors, such as mosquitoes, whose distribution and that of the associated diseases may change due to climate change. However, many found it difficult to discuss anything further in their responses, or included generic detail about climate change, and described how an increase in human density (due to warmer weather) would increase the occurrence of diseases. A few candidates included some limited detail about diseases with direct transmission and how their distribution is less likely to change. This was intended as a question where candidates could synthesise and discuss information from several points in the infectious disease area of the syllabus but, for the most part, candidates were unable to unpack the required elements of the question.

Question 39 attempted by 568 candidates Mean 8.45(/20) Max 15.5 Min 0
The mean score for part (a) was 52.1% and noticeably higher than that for part (b) at 32.4%. No candidates achieved full marks in either part (a) or part (b).

Part (a) asked candidates to discuss how the types of nitrogenous waste produced by different vertebrates are related to the availability of water in the environment and ancestry (evolutionary history) of the vertebrate. Many candidates did not appreciate the subtle aspects of the question and link the toxicity of the nitrogenous waste product to the volume of water required to safely dispose of the material. Many gave a lot of detail about the amount of energy that is required to convert ammonia to each type of nitrogenous waste, however this was not a required aspect of the question. Others gave brief table summaries of the three nitrogenous waste types that did not fully address the requirements of the question. Few candidates were able to link the nitrogenous wastes to ancestry in a meaningful manner and most did not raise any of the provided marking points in relation to this issue.

Part (b) asked candidates to discuss why it is difficult to control the spread of *Phytophthora* dieback in Australia. Although many candidates gave quite a lot of detail in their responses, they did not decode the question or stimulus material properly. Many gave details about *Phytophthora* dieback in a general sense and did not restrict their answer as to why it is difficult to control the spread. Candidates were usually able to provide broad management strategies in detail but did not always differentiate between the natural environment and in cultivated and garden plants, although they could have achieved full marks without making this differentiation.