Course report 2019

Subject	Environmental Science
Level	Higher

This report provides information on candidates' performance. Teachers, lecturers and assessors may find it useful when preparing candidates for future assessment. The report is intended to be constructive and informative and to promote better understanding. It would be helpful to read this report in conjunction with the published assessment documents and marking instructions.

The statistics used in this report have been compiled before the completion of any post-results services.

Section 1: comments on the assessment

The number of new centres presenting increased by eight but overall the number of presenting centres fell. The total number of candidates presented also decreased. As in previous years, statistics show that the majority of candidates have no previous experience of Environmental Science, with most presentations coming from S6.

Anecdotal evidence suggests that the course continues to be delivered predominantly by biologists and geographers, but also by chemists and physicists, with co-delivery common. This diversity is often apparent in candidate responses, especially in assignment topics. Marking instructions for the question papers are updated at central marking events, in order to incorporate the range of approaches originating in the different subjects. They provide a useful teaching tool.

Overall performance improved in comparison with 2018 results. However, with the smaller cohort of candidates this year, and the introduction of a new component, any comparison must be viewed with caution.

Question paper 1

Paper 1 was a new assessment component focusing on an application of Environmental Science with an emphasis on problem solving. Candidates performed very strongly in this component.

Two questions in this paper were found to be too straightforward at this level, and the grade boundary was raised to account for the low level of demand in these questions.

Question paper 2

Paper 2 followed the same format as the question paper in previous years, and statistics suggest it had a similar level of demand as the 2018 question paper.

The paired options in the essay questions appeared to be of relatively equal demand, with similar candidate performance in both. Candidate performance in the structured response options was better than performance in the unstructured responses; with a notable number of candidates achieving full marks in extended-response questions.

A number of candidates did not complete the paper. While it is possible that some candidates ran out of time, candidates who did not complete the paper tended to have missed out questions throughout the paper. This suggested that some candidates had a poor knowledge and understanding of environmental science and may have been presented at the wrong level.

Overall, paper 2 performed as intended. The inclusion of ‘suggest’ questions enables candidates to make use of their own wider knowledge and experiences, and the majority of candidates demonstrated accurate recall and applied good lateral thinking skills.

Command words are not always responded to appropriately, especially ‘describe’ and ‘explain’.

Assignment

The revised assignment requires candidates to carry out a laboratory or fieldwork-based investigation and has differing mark allocation to the previous assignment structure; results therefore cannot be compared with those from previous years.

A wide range of topics were presented, often representative of the delivering centre. In some cases, the investigation undertaken and/or subsequent handling of the data was not considered appropriate to Higher level.

Section 2: comments on candidate performance

Areas that candidates performed well in

Question paper 1

Candidates performed well in this paper, which had a significant problem-solving focus.

Question 1(a)	Naming a greenhouse gas associated with vehicle emissions. Note: where a chemical formula is used in place of the full name, it must be in the correct format, including appropriate use of capitals and subscript or superscript numbers.
Question 1(b)	Predicting the impact that dualling the road would have on vehicle emissions. The expected response was that emissions would increase as speed increased from around 50 mph to 70 mph, but some candidates demonstrated a good understanding of the science by considering the impact of stop-start congestion on emissions.
Question 1(c)(i)(A), (B)	Suggesting possible benefits of trees to wildlife and to residents along the route. The benefit to wildlife was judged to be of too low demand at this level and a mark adjustment was made.
Question 2(a)(ii)	Identifying the random sampling approach. This was judged to be of too low demand at this level and a mark adjustment was made.
Question 2(c)(i)	Identifying the species least tolerant of eutrophic conditions.
Question 2(c)(ii)	Calculating the mean trophic ranking score.
Question 3	Deciding whether to grant permission to construct the stretch of dual carriageway, with justification. Marks were awarded for developed responses, not for simply re-stating information or data provided in the various sources. The majority of candidates made good use of the sources and their own knowledge, and produced some strong arguments for or against granting permission. Where candidates discussed both sides of the argument, full marks were awarded only when the response concluded with an appropriate decision either for or against.

Question paper 2

Candidates generally performed well in questions involving accurate recall and processing of information.

Question 1(a)(i), (ii), (iii)	Stating social, economic and environmental impacts of a mudslide. A good range of responses relevant to the mudslide context was provided.

Question 2(a)(i)	Naming the type of plate boundary.
Question 2(b)(ii)	Stating a type of renewable energy generated from the Earth's internal heat.
Question 3(a)(ii)	Calculating the mass of plastic not collected for recycling.
Question 3(a)(iv)	Calculating a simple whole number ratio.
Question 3(b)(ii)	Outlining the advantages and disadvantages of either recycling or incineration.
Question 3(c)(ii)	Explaining why increasing levels of plastics can kill predators such as sea eagles.
Question 4(c)	Calculating the percentage of a radioactive substance remaining after 12 hours.
Question 5(a)(i)	Stating why two species can survive within the same habitat.
Question 5(a)(ii)	Describing long-term effects of increased red grouse numbers on a moorland ecosystem.
Question 6(d)(i)	Naming a processed biofuel that could be tested in the experimental setup.
Question 6(e)	Completing the bar graph. Plotting the data and completing the key were well done, but many candidates lost the x-axis labelling mark by not adding the *fuel* label.
Question 6(f)	Suggesting whether a driver should purchase a petrol or bioethanol-driven vehicle, with justification.
Question 7(e)	Explaining the impact of anthropogenic climate change on species distribution.
Question 8	All candidates attempted question 8 (structured essay). Mean marks for the structured essays were similar to the mean marks in 2018. The majority of candidates attempted 8B (habitat fragmentation and rewilding). In most cases, knowledge of habitat fragmentation and its impacts on species and/or biodiversity was well demonstrated, but discussion of rewilding tended to be very narrow, mostly limited to reintroduction of species and/or creation of wildlife corridors.

Candidates who attempted 8A (exponential and logistic population growth) did better when they included appropriate graphs and descriptions and/or explanations of what these displayed.

Question 9

Most candidates attempted question 9 (unstructured essay). Mean marks for the unstructured essays were slightly lower than in 2018.

Attempts were evenly split between 9A and 9B.

The majority of candidates who attempted 9A provided discussion of changes in orbital shape, and tilt and orientation of the Earth's axis (credit was given for appropriate discussion of 'stretch, wobble and roll') associated with Milankovitch cycles. Some high-quality responses included annotated diagrams plus time periods and changes in angles. However, many candidates confused the three cycles and/or did not relate these back to impacts on the Earth's climate.

Candidates who attempted 9B were often able to discuss one or two factors affecting oceanic circulation (typically thermohaline circulation and the Coriolis effect), but missed marks through not being able to name a third factor and/or provide sufficient detail about the impacts of their named factors on oceanic circulation. Inclusion of appropriate annotated diagrams could potentially have increased the marks awarded.

Assignment

Aim	Almost all candidates achieved the mark for providing a clearly stated aim.
Data collection and handling:	
♦ sufficient raw data from the candidate's experiment/ fieldwork ♦ data/ information from an internet/ literature source	Most candidates provided sufficient raw data. Many candidates undertook two related fieldwork investigations, whereas laboratory-based data tended to be restricted to a single experiment with secondary data obtained from an internet or literature source.
Graphical presentation:	
♦ appropriate graph format ♦ suitable axis/axes scale(s) ♦ suitable axis/axes labels and units ♦ accurately plotted data points	The majority of candidates produced well-presented hand-drawn graphs, and these achieved higher marks than graphs produced in previous years. However, accurate plotting of data points was not done as well as the other graphing elements.
Analysis	Candidates continue to find this a challenging skill but are becoming more competent at interpreting their findings.
Structure	Most candidates achieved the mark for providing a clear and concise report with an informative title. Where the mark was not awarded, this was typically for not including a title.

Areas that candidates found demanding

Question paper 1

Question 2(b) Explaining the impact of eutrophication on biological oxygen demand.

In many cases, a poor understanding of both eutrophication and BOD was evident, and more specifically that a high (aerobic) bacteria population will result in a high BOD.

It should be noted that pesticides are not a cause of eutrophication.

Question 2(b)(ii) Suggesting a strategy that could be used to reduce eutrophication, with justification. Most candidates were able to suggest a suitable strategy to prevent nutrient-rich waste entering the loch, but the justification for the strategy was often poorly explained.

Question paper 2

Candidates continue to struggle with the difference between 'describe' or 'explain' command words. Definitions were also problematic, both when asked for the definition of a given term and when given the definition asked for the term.

Question 1(c)(iv) Explaining the sequence of changes shown in the succession diagram. The majority of candidates *described* what was shown rather than explaining why it was occurring.

Question 2(a)(ii) Explaining how convection currents drive (constructive) plate boundary movement. Information about plate movement was provided in the diagram, so a candidate unable to name the type of plate boundary was not disadvantaged. Credit was given for appropriate annotated diagrams with explanatory statements.

Question 2(b)(iii) Explaining why Iceland's location on an active plate boundary offers a large potential for renewable energy generation. The diagram included volcanoes occurring along the plate boundary, from which candidates could deduce that hot magma is close to the surface and therefore offers the potential for geothermal energy production, from groundwater (steam and hot water) and/or ground source ('hot rocks').

Question 2(b)(iv) Calculating the temperature change per km of depth. While the majority of candidates correctly calculated the temperature change **per metre** of depth, only a small number then converted the value to per km of depth.

Question 3(c)(i) Defining *bioaccumulation*. The majority of candidates continue to confuse this with *biomagnification*.

Question 3(c)(iii)	Naming a species that has been reintroduced into Scotland. The most common incorrect species were red squirrel, wolf and lynx.
Question 4(a)(ii)	Describing a property of a named radioactive source that makes it suitable for nuclear energy production. The majority of candidates answered this very poorly or did not attempt the question.
Question 4(b)	Describing how electrical power can be generated through nuclear fission. Around half of candidates achieved 0 or 1 mark, frequently due to a lack of knowledge and understanding of nuclear fission.
Question 4(d)	Stating two roles of SEPA. Around one-third of candidates were unable to correctly name a role of SEPA, either in relation to radioactive substances or to the common roles SEPA shares with other key environmental agencies in Scotland.
Question 5(b)(i)	Stating the term *ecological efficiency* from the definition provided. A high number of candidates either answered incorrectly or did not attempt the question.
Question 5(b)(ii)	Explaining why food chains containing ectotherms tend to be longer than those containing mainly endotherms. The majority of candidates confused *endo*- and *ecto*- and/or were also unable to discuss the transmission of energy up the food chain.
Question 6(b)	Explaining why biofuels can be described as a renewable energy source. Many candidates described a property of biofuels but did not expand further.
Question 6(d)(ii)	Identifying an improvement to the experimental set up to increase validity, with justification. Over half the candidates achieved 0 marks or did not attempt the question. The majority of incorrect responses did not relate to the set up shown in the diagram, while others achieved partial marks because they did not provide justification.
Question 7(a)	Stating a factor that could lead to water insecurity (other than high temperatures and low rainfall). A wide range of answers were accepted but only if they related to water insecurity (such as damming by another state, over-extraction, or contamination), not just to increased demand.
Question 7(b)	Explaining why drip irrigation minimises water usage. The majority of candidates discussed delivering water directly to plant roots but then did not explain why this minimised water loss.
Question 7(b)(ii)	Naming an agricultural practice that aims to save water (other than drip irrigation). Growing drought-resistant crops, mulching, hydroponics, or use of ‘magic stones’ were acceptable responses,

	but not growing GM crops (unless expanded to relate to drought resistance).
Question 7(c)	Most candidates were unable to describe the difference between greywater and blackwater.
Question 7(d)(i)	Stating what is meant by a *policy*. Most candidates incorrectly described it as legislation, rather than as a plan of action.

Assignment

Data collection and handling: summary of data collection approach(es)	Many candidates provided overly lengthy summaries or step-by-step methods. The approach(es) used to collect the xperimental/fieldwork data should be summed up in as few sentences as possible, while still naming the measuring equipment and/or the chemicals used.
tabulation of raw data	There appears to be some confusion over the tabulation of data, with some candidates taking tables including additional columns (for calculations) and/or completed calculations into the report-writing stage. Raw data from the experiment/fieldwork should be displayed in a table that has clear column headings and units, and this can be taken into the report-writing stage. This table should not contain additional columns or column headings intended to assist the candidate in completing mean and/or derived value calculations, nor should it include previously completed calculations. The additional columns and calculated values should be added during the report-writing stage, either by extending the raw data table or by displaying these in a separate table.
data or information obtained from the internet/ literature, or data obtained from a second experiment/ fieldwork investigation	Where candidates carry out a single experiment or fieldwork investigation, they must then obtain a second set of data from an internet/literature source (that must have an accompanying citation beside the data and a separate reference later in the report). Where candidates carry out two experiments/fieldwork investigations and therefore obtain two sets of data, there is no need to find an additional source of data/information from the internet or literature. In this case, the candidate must cite and reference a source of information included in the underlying environmental science section. Note: care must be taken when considering whether experiments/fieldwork activities constitute a single experiment

	or two experiments. For example, if the aim is to determine the impact of one variable on another, such as the effect of light level on the growth of pleurococcus around tree trunks, this would constitute one experiment/fieldwork investigation. Therefore, a second set of data/information from an internet/literature source would also be required (and should be cited and referenced). Another example would be comparing soil types at two different locations — this would be the same method for soil samples from both locations and so would constitute only one experiment.
Graphical presentation	Soil texture investigations were common, based on sedimentation tests. The sand, silt and clay content is typically displayed on a triangular graph and then compared with a soil texture classification diagram. Where triangular graph paper is provided for candidates, teachers and lecturers should ensure that this does not include any scales or labels. Note: the UK soil texture classification diagram differs slightly from the US version (specifically in the lower tiers); if the US version is mistakenly used, the outcome will not correlate with the BGS *my*Soil mobile phone app or other UK sources. Candidates were not penalised for using the US version but the analysis mark was only awarded if they made the point that there was a difference between their findings and the (UK) source.
Data collection and handling:	
citation and reference	Referencing a source of internet/literature data or information was relatively well done, with most candidates including all the required details, and placing the reference later in the report (usually at the end). However, many candidates did not appropriately **cite** the referenced source, instead often placing the reference beside the point in the report where the source had been used. While the reference may have been correct, using it in place of a citation meant that the mark was not awarded.

Analysis:

extended or statistical calculation	The calculation must be based on the experimental/fieldwork data. Many candidates included a calculation that did not relate to the overall investigation (typically percentage change calculations), and therefore contributed little towards the conclusion. However, it was encouraging to see a wide range of different calculation types employed, including some not listed in the assignment guidelines (nearest neighbour analysis, Spearman's rank correlation).
Conclusion	The majority of candidates did not achieve the conclusion mark. Often this was due to a poor understanding of the difference between *conclude* and *evaluate*, but also because of a failure to relate the conclusion to the aim and to **all** the data in the report. The conclusion must relate to the aim and both sets of data (whether the second set is from an internet/literature source or a second experiment/fieldwork investigation), and the outcome of the extended or statistical calculation.
Evaluation	This was poorly done, with a number of candidates awarded 0 marks. Some candidates evaluated an internet/literature source of data/information (rather than the data itself). This no longer gains a mark.

Section 3: preparing candidates for future assessment

Teachers and lecturers are encouraged to attend the Understanding Standards event for this course and/or access the materials that will be available on the Understanding Standards website after the event. These include examples of candidate evidence, with accompanying commentaries, which aim to help teachers and lecturers develop an understanding of the required assessment standards. Teachers and lecturers may find it useful to ask candidates to 'blind mark' these, to develop their understanding of the requirements.

Question papers 1 and 2

It is strongly recommended that teachers and lecturers provide candidates with a copy of the mandatory content tables available in the course specification. This enables candidates to familiarise themselves with phrasing and terminology used in the section headings and sub-headings in the first column, as these are often included in question stems, especially the extended-response questions. Past question papers and the specimen question paper can be used to prepare candidates.

There were a number of specific areas where candidates' knowledge and understanding were noticeably lacking: eutrophication and BOD, and the link between them; understanding of seral stages in succession; convection/heat transfer as a driver of plate boundary movement; bioaccumulation and biomagnification; nuclear energy in general, but particularly the process of nuclear fission; and the main roles of SEPA.

Marks continue to be lost through misunderstanding of command words, so teachers and lecturers are encouraged to incorporate these into teaching at an early stage. Command words causing problems for candidates include: describe, explain, conclude, and evaluate.

While some candidates avoid tackling graphing questions and calculations, it is important that they practise these, especially calculations including large values and statistics. Statistical formulae are provided in question papers where appropriate, and candidates should be familiar with substituting values in formulae and interpreting the results.

Candidates should be encouraged to plan their extended-responses (and include the planning notes), perhaps right at the start of the exam before attempting the restricted response section. Planning notes will be marked if it is obvious the candidate has run out of time, providing the notes have not been scored through. Practise in writing extended-responses, without bullet points (unless as lists or points that are then further expanded) should be encouraged.

Candidates should be encouraged to write as clearly as possible, so that marks are not lost owing to the marker being unable to read the response. Candidates should also be reminded to write in full sentences rather than brief statements or phrases, as these often include insufficient detail for the available mark(s).

Assignment

Teachers and lecturers should ensure at an early stage that candidates fully understand what they are being asked to do. It is strongly recommended that candidates are provided with a copy of the coursework assessment task, and are familiar with the marking instructions, at the outset, as this will allow them to see where marks will or will not be awarded.

It is important that candidates have a choice of topic. When giving candidates a free choice of investigation would be difficult for a centre to accommodate, the requirement could be met by offering a specific range of practical/fieldwork investigations and managing candidate choice.

Candidates are permitted to either work individually or in a small group of two, three or four for the experimental work/fieldwork. Internet literature research must be the work of each individual candidate. Ensuring a range of topics are being investigated within a class and that internet/literature research is the work of the individual, should avoid candidates producing very similar reports.

For the underlying environmental science section, candidates should develop the skill of summarising and linking key points from different sources and discussing these in their own words. This skill is also important with regard to the investigative approach(es) undertaken.

The sources used, and discussion of the content, should be at a level at least appropriate to Higher, and at least one source used should be appropriately cited and referenced. While use of a formal citation system is not a requirement, candidates must include an indication of the source at an appropriate place in the report (for example, a superscript or bracketed number beside the use of the information/data), which clearly links to a reference placed later in the report, typically at the end.

It is important that candidates are not provided with a template of any form.

Candidates should practise graphical presentation and, without intervention from the teacher or lecturer, consider which graphical format is most appropriate for their data. If using a software graphing package, they must ensure that minor gridlines are included and the points plotted are not overly large. It must be possible to check the accuracy of plotting.

Candidates should practise data analysis, identifying and clearly describing any evident relationships. Where one experiment/fieldwork activity has been carried out, they must compare their data with an internet/literature source of data. If two experiments/fieldwork activities have been undertaken, they must discuss both sets of generated data. Where the impact of one variable on another is being considered, this should be treated as a single investigation, in which case data/information must be obtained from an internet/literature source or data from a further related investigation.

The extended or statistical calculation must be based on the experimental/fieldwork data and should be relevant to the investigation, so that the outcome can be considered in the conclusion.

Candidates should be encouraged to critique all steps of their investigation and supply appropriate justification.

SQA's criteria on assessment conditions are published on the website and in course materials and must be adhered to. SQA takes very seriously its obligation to ensure fairness and equity for all candidates in all qualifications through consistent application of assessment conditions, and investigates all cases where conditions may not have been met.

Grade boundary and statistical information:

Statistical information: update on courses

Number of resulted entries in 2018	423

Number of resulted entries in 2019	392

Statistical information: performance of candidates

Distribution of course awards including grade boundaries

Distribution of course awards	Percentage	Cumulative %	Number of candidates	Lowest mark
Maximum mark				
A	19.4%	19.4%	76	107
B	19.9%	39.3%	78	92
C	29.1%	68.4%	114	77
D	17.6%	86.0%	69	62
No award	14.0%	-	55	-

General commentary on grade boundaries

SQA's main aim is to be fair to candidates across all subjects and all levels and maintain comparable standards across the years, even as arrangements evolve and change.

SQA aims to set examinations and create marking instructions that allow:

- a competent candidate to score a minimum of 50% of the available marks (the notional C boundary)
- a well-prepared, very competent candidate to score at least 70% of the available marks (the notional A boundary)

It is very challenging to get the standard on target every year, in every subject at every level.

Therefore, SQA holds a grade boundary meeting every year for each subject at each level to bring together all the information available (statistical and judgemental). The principal assessor and SQA qualifications manager meet with the relevant SQA head of service and statistician to discuss the evidence and make decisions. Members of the SQA management team chair these meetings. SQA can adjust the grade boundaries as a result of the meetings. This allows the pass rate to be unaffected in circumstances where there is evidence that the question paper has been more, or less, challenging than usual.

- The grade boundaries can be adjusted downwards if there is evidence that the question paper is more challenging than usual.
- The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual.
- Where standards are comparable to previous years, similar grade boundaries are maintained.

Grade boundaries from question papers in the same subject at the same level tend to be marginally different year to year. This is because the particular questions, and the mix of questions, are different. This is also the case for question papers set by centres. If SQA alters a boundary, this does not mean that centres should necessarily alter their boundary in the question papers that they set themselves.