Environmental systems and societies SL

Timezone 2

To protect the integrity of the assessments, increasing use is being made of examination variants. By using variants of the same examination, candidates in one part of the world will not always be responding to the same examination content as candidates in other parts of the world. A rigorous process is applied to ensure that the content across all variants is comparable in terms of difficulty and syllabus coverage. In addition, measures are taken during the standardisation and grade awarding processes to ensure that the final grade awarded to candidates is comparable.

Contents

Grade boundaries

Standard level overall

Grade:	1	2	3	4	5	6	7
Mark range:	0-10	11-22	23-34	35-44	45-54	55-64	65-100

Standard level internal assessment

Grade:	1	2	3	4	5	6	7
Mark range:	0-4	5-8	9-13	14-16	17-20	21-23	24-30

Standard level paper one

Grade:	1	2	3	4	5	6	7
Mark range:	0-4	5-9	10-14	15-18	19-22	23-26	27-35

Standard level paper two

Grade:	1	2	3	4	5	6	7
Mark range:	0-5	6-11	12-17	18-23	24-28	29-34	35-65

Standard level internal assessment

The range and suitability of the work submitted

Generally, the range of the work submitted was good and appropriate. Compared to last year, the work submitted was more suitable with a wider range of types of IAs (more field work, lab experiments compared to previous covid-impacted years with more surveys & secondary data). Whilst there were still many of the typical IAs like acid rain/salinity/fertiliser germination experiments, there was more curiosity with more unique research questions being created. Fast fashion, and air quality were popular EIs.

However, there are still quite a few IAs submitted that did not follow the standard format of an ESS IA and were written as essays on an environmental issue with no method outlined or data collected. Additionally, some IA reports could as well be submitted in a different subject (e.g., Geography or biology) because of the lack of an explicit EI.

The use of field study centres has returned after the Covid years. This can mean very similar investigations with slight modifications.

The use of ChatGPT and other AI to help craft the plan or analysis and in some cases the data was seen. This was referenced but was not usually appropriate for an IA.

The collection of sufficient data is still a concern with secondary data and surveys. The collected data should be sufficient to apply statistical tests that help answer the RQ.

The use of *E. coli* was concerning in some investigations. The IB experimentation policy must be followed regarding the use of microorganisms like *E. coli*.

There were fewer reports using appendices.

Candidate performance against each criterion

Identifying the context

The majority of RQs were relevant to ESS, and often included the EI. Students generally perform well in this criterion. The students can provide the context for the RQ by discussing the EI.

Common areas of weakness are unfocused or broad RQs, a too general EI and poor linking of the EI to the RQ asked.

RQs in general could be more focused, many were vague e.g., 'testing water quality or measuring air pollution'.

Some EIs are still only focused on human health. This is not appropriate for ESS.

The choice of the EI should inform the decision on the wording and focus of the RQ. The third aspect making the connection is essential here.

Planning

All students, bar a few, attempt a plan. Planning for sufficient data collection to answer the RQ and providing justifications for the choices made in the plan are often the hardest aspects of this criterion. The aspect most often missing is the ethics & risks.

The procedure to collect data should enable the investigation to be repeated. The method is often lacking in enough details to ensure repeatability. Field based investigations must detail the rationale for the site choice, and detail the actual sites chosen. Then the collection of a sample or data from the site must also be specified.

Survey or questionnaire investigations should include the questions and justify why these questions are asked. The survey should not be in an appendix. How and why the participants are chosen, and how the survey is distributed are part of the procedure for a survey.

Secondary data investigations must mention the source used to collect the data and the ethics behind why this is a suitable data source. How the data is extracted from the database or website should be detailed in the plan.

In laboratory investigations the justification for the independent variable treatments should be given.

The collection of sufficient data varies depending upon the type of statistical manipulation that will be done to answer the RQ. This must be addressed in the plan. Secondary and survey data usually require more data points than a lab-based investigation.

There is no need to copy out test kit instructions or how to set up a spreadsheet, calculate statistics or how to create a survey. It is sufficient to state that an application or kit has been used, giving the name for repeatability purposes.

Some students had a planning section that did not address the RQ.

Results, analysis, and conclusion

All raw data collected and used to reach a concussion should be in this section of the report. Several students included the raw data in an appendix. This is not appropriate.

All raw data should be processed in some way to show the patterns and trends that allow the RQ to be answered in a conclusion. Various statistical tests appropriate to the data collected can be applied to the data to help determine a conclusion. Most students attempted some processing of the raw data, even if the raw data was initially graphed. A wide range of statistical tests were used by students. All calculations must be checked by the teacher to ensure the maths is correct.

Secondary data and surveys had instances of students presenting data and graphs/charts they had not created themselves. Generally, these presentations do not directly answer the RQ making the analysis and conclusions being drawn weak.

Students that included a calculation of validity or reliability and referred to this in the conclusion tended to do well in this criterion.

Discussion & Evaluation

The discussion aspect of this criterion is often very brief, missing or does not relate the conclusion to the EI. Stronger investigations have students who use literature and research, as well as their own data to refer to the EI.

The evaluation aspects are generally answered in more detail. Most students can identify or describe strengths, weaknesses, and limitations, and many can discuss these. The modifications for the weaknesses and limitations are usually appropriate but often are not detailed enough. Most students are now attempting some further areas of research, but these can be rather superficial.

Application

Most investigations included a solution. Several students add this to the end of the DEV section rather than having a separate section. It is always a shame to see students not include this criterion at all.

There were many generic solutions with a general evaluation using "more education" or "awareness campaigns". Students seem to find it difficult to have one named solution and then evaluate this. Rather they describe several solutions and give a general evaluation.

Communication

The reports are generally well constructed and clear. They are organised and use appropriate ESS terminology.

The conventions of using metric, scientific naming conventions and labelling tables, figures and graphs should always be followed for clarity.

The use of an appendix is penalised in COM.

Reports that used an essay format and had very limited or no sections did not meet aspect 1 or 3 of this criterion.

Most students kept within the 2250-word count. Some students try to circumvent the word count using tables for the plan or evaluation, or even analysis.

Recommendations and guidance for the teaching of future candidates

The report should not contain school, teacher, or student information.

The use of an appendix is inappropriate, it will not be marked.

Academic integrity should be followed, and appropriate citations should be made using a consistent referencing system. All source material must be referenced.

All the criteria should be practised through the practical activities prior to the IA being undertaken.

The IA assessment criteria should be shared with the students and students should have seen some exemplars of complete IA reports.

Teachers should approve the RQ and plan before the student starts to gather data. This should include an indication from the student on which statistical tests they wish to use. The teacher can provide verbal feedback on whether the student's plan and processing will answer the RQ. A descriptive or a human health RQ is not appropriate.

Teachers must give feedback on one complete report and allow the student to edit their report.

Teachers need to provide comments on the final submitted reports to explain the mark they are awarding for a criterion.

Students would benefit from practising writing plans for a variety of types of investigation. Including site choices and sample techniques for fieldwork, extracting data from a database and the sharing of a survey. All plans should be in enough detail for repetition.

All plans must have an ethics & risks section.

Raw data must be included in the main body of the report. The details of the processing formula or tool should be stated and ideally a worked example shown.

Data cannot be copied and pasted from a survey or a secondary data source and be considered suitable for the investigation.

Appropriate graphical or display techniques for the data and manipulation should be done. For example, calculating an average of growth over time is not appropriate. Then plotting this on a bar chart does not help answer an RQ looking at whether a change influences growth.

All validity or reliability manipulations should be commented upon in the analysis or conclusion.

The evaluation should look at main issues with the written and actual procedure done.

Only one solution is required in the APP section and this solution should be evaluated. This solution and evaluation should not be generic but rather specific for the EI and conclusion.

An accurate word count should include all components that count towards a mark. Plans and evaluation in table format will still be part of the overall word count. Data, citations/bibliography, figure titles and section headings are not counted as part of the word count.

Further comments

Teachers need to ensure they use the ESS marking criteria and not group 4. Tables with more than ten words in them count towards the word count and students need to be reminded of this.

Teachers should revisit the FAQs for ESS, as ESS is an interdisciplinary subject.

Standard level paper one

General comments

The majority of G2 respondents considered the difficulty of the paper to be appropriate. Compared to the paper from last year, approximately 61% considered it to be of a similar standard, 32% believed it was more difficult and 7% thought it was easier. The quality of the paper in terms of clarity of wording, presentation, readability, suitability, and inclusivity was considered by most respondents to be either acceptable, good, or very good.

The areas of the programme and examination which appeared difficult for the candidates

- Understanding the requirements of command terms such as explain (e.g., Q1c) and outline (e.g., Q3a and Q3b).
- Using subject specific vocabulary and terminology. E.g., for Q4, instead of using the term "pollutants", nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) should be referred to or instead of stating "changes/affects", an "increase" or "decrease" should be specified.
- Explaining in sufficient detail the reasons for the reduction in the under 30 age groups and linking the reasons to a fall in birth rate (Q1c).
- Calculating the average annual increase in energy demand, including showing workings and rounding the value correctly (Q2a).
- Understanding how coal consumption could have been reduced (Q2b).
- Understanding reasons for high levels of $PM_{2.5}$ in December (Q3a).
- Understanding factors that contribute to the formation of tropospheric ozone (Q3b).
- Understanding the causes and management of acid rain (Q4).
- Understanding the advantages of using a biotic index (Q8bii).

Understanding the role of zoos in conservation and the purpose of active breeding programmes to increase the population of endangered species to:

- increase genetic diversity.
- be able to reintroduce them into the wild.
- prevent them from going extinct (Q10a).
- Writing an appropriate conclusion which uses positive and negative examples and includes a clear judgement statement (Q11).

The areas of the programme and examination in which candidates appeared well prepared

Most candidates did well with interpretation of data from the figures within the Resource Booklet and performed well on Q1b, Q5a and Q8a.

Candidates also did well with:

- suggesting reasons for changes in modes of transport (Q5b)
- outlining advantages of greening the city (Q6)
- outlining a method of water conservation (Q7a)
- evaluating the water diversion project (Q7b)
- outlining an advantage of using a dead hedge (Q10b)
- presenting arguments both for and against Beijing being a model of good environmental management (Q11).

Most candidates appeared to manage their time well, completing the exam and providing a response to most questions.

The strengths and weaknesses of the candidates in the treatment of individual questions

Question 1

Q1(a) The majority of candidates answered this question well with popular responses referring to an increase in access to medical and health care or the relocation of industry resulting in improved air quality.

Q1(b) Most candidates correctly answered this question.

Q1(c) Responses to this question were highly varied. A common error was not linking the reason given to a reduction in birth rate i.e., linking the action to the results.

Question 2

Q2(a) Many candidates struggled to answer this question with some not attempting the question at all. Some candidates gave the final answer without showing their workings or inappropriately calculated percent increase.

Q2(b) Responses varied widely for this question, with many correctly describing the use of a renewable source of energy such as hydroelectric power to reduce coal consumption. A common error was to suggest that cars ran on coal and therefore by limiting car ownership, coal consumption would be reduced.

Question 3

Q3(a) Responses often lacked the detail required for credit. Many answers stated that heating was required to keep warm in December but did not link this to the combustion of fossil fuels which resulted in higher levels of PM2.5.

Q3(b) Responses varied significantly, with many correctly linking higher sunlight levels in the summer to increased ozone levels. Several responses only stated 'temperature' or 'sunlight' without outlining how these factors affect ozone levels. Some responses confused tropospheric ozone to stratospheric ozone.

Q3(c) This question was well answered by many candidates. The most popular response referred to WHO not being subject to national political bias.

Question 4

Q4 Few candidates answered this question well. Most responses did not make the link between acid deposition and declining levels of NO2 and SO2 as illustrated in Figure 6(e). A common error was to use the generic term pollutant rather than to specify NO2 or SO2.

Question 5

Q5(a) This question was very well answered by most candidates. Most popular responses were a reduction in use of bicycles and an increase in the use of subways.

Q5(b) Many candidates answered this question well. A common error was not to link the trend (which was the effect) to the cause.

Question 6

Q6 This question was well answered by many candidates. Many correctly stated that plants act as carbon sinks and provide a habitat for wildlife. Responses such as 'improves air quality' or 'increases biodiversity' were too vague to be credited.

Question 7

Q7(a) Most candidates answered this question well and were familiar with a range of water conservation methods.

Q7(b) This question was generally well answered, with many candidates showing their ability to apply their own knowledge to the case study. A common error was to only consider the pros and not the cons of the project.

Question 8

Q8(a) This question was well answered by most candidates.

Q8(b)(i) Many candidates answered this question correctly. Common responses referred to identifying the pollutants or identifying the number of pollutants.

Q8(b)(ii) Responses were mixed for this question. A significant number of candidates appeared to struggle with this question and left a blank response. The most common response recognised that biotic index measures the impact of the pollutants on the habitat or community.

Question 9

Q9 There were a wide range of responses for this question with many candidates achieving at least one mark. A common error was to state that landfills caused pollution without explaining how or what type of pollution.

Question 10

Q10(a) There were mixed responses to this question. Many candidates stated that the zoo allowed species to reproduce but did not link this to increasing genetic diversity, releasing species back into the wild or preventing species from becoming extinct. Few candidates referred to the role of zoos in raising funds for conservation or increasing awareness through education programmes.

Q10(b) This question was answered well by most candidates. Most responses recognised that the dead hedges created a habitat for wildlife.

Question 11

Q11 Most candidates achieved some marks for this question, but few achieved the full 6 marks. Some responses inappropriately repeated material from the resource booklet without connecting the facts provided to the question being asked. Few candidates were able to provide a well-balanced conclusion. Many conclusions were either one sided or vague.

Recommendations and guidance for the teaching of future candidates

- Students should be encouraged to read the question carefully and thoroughly. Students should practice reading exam style questions to try and understand what is being asked and then how to answer the question directly.
- The requirement of each command term should be taught. It may be useful to practice answering the same question using a different command term to really understand the difference between describe, explain, evaluate etc. Notably both outline and explain require the link to be made between the action and the result. Students should also know which command term requires them to include counter arguments and a clear conclusion/appraisal.
- Students need to practice reading data from a wide variety of charts and graphs including compound bar graphs. It may be useful to increase the use of different types of graphs as a teaching tool to try and help improve interpretation of data and where appropriate extraction of data for use in calculations.
- Students should be given examples of the range of calculations used in ESS and provided regular opportunities to practice these.
- Students should be taught how to plan a 6-mark question with for and against arguments. They should be taught and be able to practice how to write a well-balanced conclusion with a clear value judgement supported by evidence. Providing students with exemplars of good conclusions from the mark scheme and encouraging them to write further examples could be helpful. An introduction for these final 6 marks question is not required.
- Students should be encouraged to consider the number of marks that are awarded to a question and ensure that enough information has been included to earn full marks (e.g., reasons, impacts, limitations, or examples).
- Students should be encouraged to give focused answers to questions using appropriate ESS terminology. They should avoid using generalised words or phrases such as "pollution/emissions", "impacts/affects", “change” or “greener” as these are too vague for credit. Responses need to be specific, for example, if pollution is being emitted, what kind of pollution and what is its impact.
- Students need to ensure that handwriting is clearly legible. If answers are not readable, they cannot be credited. Only dark ink should be used as scripts will be scanned and marked on-screen.
- Students need to keep their responses within the answer box and if extra space is required continue the response on additional pages. If continuing an answer on additional pages, the student should mark "see answer booklet" at the end of the answer box and write the exact number of the question on the additional page.
- Students should be discouraged from leaving blank responses.

Students need to apply their subject knowledge and understanding of ESS to this paper. Hence, educators need to ensure the whole syllabus is covered in sufficient detail. This includes ensuring students:

- are able to do a variety of calculations including percentages, percentage increases/decreases, annual increases/decreases.
- can correctly round numbers to two decimal places.
- understand the factors that influence changes in the age-gender pyramid over time and explicitly articulate the link between cause and effect.
- understand ways in which use of fossil fuels such as coal can be reduced.
- understand the difference between tropospheric and stratospheric ozone.
- understand the factors which influence the formation of tropospheric ozone.
- understand the causes of acid deposition and how these can be reduced.

- understand the advantages and disadvantages of using a biotic index.
- understand the role of zoos and active breeding programmes in species conservation.

There were many scripts this session that were not legible and therefore hindered accurate assessment. Schools need to provide guidance and support to improve students' handwriting skill. Schools should also organise access arrangements for students with very poor handwriting (details of which can be found in the IB Access and Inclusion Policy).

Students are often writing outside the answer box, this needs to be avoided as part of the answer may be accidently missed when marking.

Standard level paper two

General comments

In general, the feedback from schools affirmed the quality and fairness of the paper. For the first time this year, two separate time zones were instituted for the exam, so two similar, but different, papers were examined. For this time zone there was a marginal improvement in the mean scores compared to last year which may be related to the distribution of candidates in the time zones.

The areas of the programme and examination which appeared difficult for the candidates

Accurately reading values from a graph; transfer and transformation of energy along a food chain; impacts of fossil fuel use on abiotic features of oceans; impact of agricultural strategies on sustainability; changes in soil qualities throughout succession; fundamental mechanisms of evolution/speciation; full range of conservation strategies; influence of geographical location on ecological footprint; practical application of Lincoln index.

The areas of the programme and examination in which candidates appeared well prepared

Interpreting information from a graphic; threats to biodiversity; cause and impacts of ozone depletion; significance of reforestation in mitigation of global warming; energy choices of different nations; efficiency and impacts of food production; population interactions; characteristics of environmental value systems; full range of strategies for addressing pollution management and their relative sustainability.

The strengths and weaknesses of the candidates in the treatment of individual questions

Section A

1a the vast majority were able to identify the correct category of species referred to from the graphic.

1b. Candidates were often able to hypothesise reasonable causes of endangerment to amphibians from a very basic knowledge of their biology, though some clearly struggled with this question.

1c. Most were able to read the percentage values from the graph.

1d. Most were able to suggest a valid reason for difficulty in obtaining data regarding abundance of sharks and rays.

1e. Many candidates were familiar with the impact of global warming and ocean acidification on corals, though only a few could come up with a third reasonable suggestion.

1f. A good number of candidates recognised habitat and genetic diversity as alternative measures of biodiversity although some became confused with responses such as biotic or Lincoln indices.

2a. Most were able to identify the major declining trend of the graph though quite few failed to comment on it becoming more stable or rising toward the end.

2b. Most were able to identify a chemical responsible for ozone depletion, usually chlorofluorocarbons.

2c. The great majority identified an impact on plants of increased UV radiation due to ozone depletion, though quite a number mistakenly put it down to dehydration.

2d. Majority could identify the year in which ozone levels would be restored, though they didn't all do it with sufficient accuracy and just went for the nearest rounded number.

2e. Many candidates correctly referred to the ban on CFCs as a cause of ozone regeneration but often could not generate a second valid response (e.g., development of alternatives, greater awareness, international cooperation, reformation etc).

2f. A good number of responses suggested some valid reason for unreliability of the data though many responses were just too vague.

3a. Most candidates came up with an example of freshwater storage in the hydrological cycle though a good few mistakenly offered "oceans".

3b. Candidates much less frequently were able to identify an input of water into the atmosphere.

3c. Many candidates identified the first half of a negative feedback cycle (i.e., higher temperature –> more transpiration/cloud formation) but slightly fewer were able to complete the second half (i.e., more clouds –> more albedo/lower temperature)

3d. Great majorities were able to identify CO_2 absorption as one positive aspect of reforestation, but few were able to add to this further advantages or disadvantages of reforestation as a mitigation strategy.

Section B

4a. Although most candidates were familiar with the basic mechanisms involved in the first trophic levels, few could focus sufficiently on what has happening to energy and the different forms it takes.

4b. Although many responses were limited in the scope they covered, most candidates could identify at least a couple of impacts from fossil fuel use on the abiotic conditions of oceans.

4c. This was generally well-answered with many relevant examples of national energy choices along with discussing the relative significance of their geographical location and environmental impacts.

5a. Majority of candidates were able to identify at least a couple of relevant agricultural strategies but could not always explain their influence on sustainability.

5b. Candidates often struggled with this question only offering one or two ways in which soil is impacted by succession.

5c. While weaker responses failed to identify specific food production systems, most candidates were able to identify aspects of efficiency and environmental impacts and utilise these in some degree of evaluative argument.

6a. Majority of candidates scored at least a couple of marks on this question but often failed to identify two further examples of appropriate population interactions.

6b. Most candidates could recognise the role of isolation of populations but were unclear regarding the fundamental mechanisms of evolution. A common misunderstanding was that new species only came about through the hybridisation of existing species.

6c. Responses were generally quite good with candidates were clearly able to link different value systems with respective approaches to conservation.

7a. This was a challenging for many who had clearly not considered the influence of geography on a population's ecological footprint, but many were able to apply their understanding of the EF concept to generate valid answers.

7b. Most candidates appeared familiar with the concept of natural income but were not always able to provide details of a suitable method for measuring the size and growth of a herbivore population.

7c. This question was often answered very well including references to a full range of strategies for addressing population management along with a balanced evaluation of their impact on sustainability. Weaker responses lacked the range of strategies and focused solely on pros or on cons, leaving an unbalanced evaluation.

Recommendations and guidance for the teaching of future candidates

There was a quite noticeable improvement in candidates' treatment of part c questions. Many went well beyond the straightforward recall of relevant knowledge statements and were able to construct clear and balanced arguments which is essential in meeting the higher mark band criteria. It was clear they had been trained to consider both sides of a structured argument in reaching an objective conclusion. This is nevertheless an area that could prove fruitful for a lot of candidates that are tending to simply list a few points with which they are familiar.

A feature that appeared to be particularly prevalent in this cohort was a tendency to leave blank responses wherever the candidate was unfamiliar with the question or to give only brief singular points when there was a plurality of marks available. There was probably a great deal of credit available that might have been fruitfully exploited with some intelligent guesswork and lateral thinking.