Environmental systems and societies SL

Contents

Grade boundaries

This DP/CP N22 subject report contains overall subject boundaries only, unlike previous reports where component boundaries were also published; component boundaries for this session are available in IBIS. The IB advises schools not to use component boundaries for this session as direct indicators of academic standards for future exam preparation because they have been set in response to the particular needs of the N22 cohort. Two significant conditions which do not normally feature in grade boundary setting have had to be satisfied during the boundary setting for the N22 session: the need to apply reasonable standards to adjusted assessment models for students who have restricted access to learning during the COVID pandemic and the need to maintain parity with students who undertook the non-examination route.

Los informes generales de las asignaturas del PD y el POP de noviembre de 2022 contienen solo los límites de calificación de las asignaturas en sí, a diferencia de los informes de otros años, que también incluían los límites de calificación de los componentes. Estos últimos se publicarán en IBIS para esta convocatoria. El IB aconseja a los colegios no usar los límites de calificación de los componentes de esta convocatoria como indicadores de estándares académicos para la preparación de exámenes en el futuro, ya que se han establecido como respuesta a las necesidades particulares de la promoción de noviembre de 2022. Durante el establecimiento de los límites de calificación para la convocatoria de noviembre de 2022 se tuvieron que acatar dos condiciones importantes que normalmente no están presentes en este proceso: la necesidad de aplicar estándares razonables a los modelos ajustados de evaluación para los alumnos con acceso restringido al aprendizaje durante la pandemia de la COVID y la necesidad de mantener la paridad con aquellos alumnos que tomaron la opción sin exámenes.

Ce rapport pédagogique de la session de novembre 2022 pour le Programme du diplôme et le POP ne fait état que des seuils d'attribution des notes finales pour la matière, contrairement aux rapports précédents dans lesquels les seuils des composantes étaient également publiés. Pour cette session, vous pourrez consulter les seuils des composantes sur IBIS. L'IB recommande aux établissements de ne pas utiliser les seuils des composantes de cette session comme indicateurs des normes pédagogiques à suivre pour la préparation aux prochains examens. Ces seuils ont été établis pour couvrir les besoins particuliers de la cohorte de novembre 2022. En effet, nous avons dû prendre en compte deux nouveaux éléments importants pour les seuils d'attribution des notes finales de la session de novembre 2022. Tout d'abord, nous avons dû appliquer des normes raisonnables aux modèles d'évaluation adaptés pour les élèves dont l'apprentissage a été freiné pendant la pandémie. Puis, nous avons dû assurer une parité avec les élèves qui ont suivi le modèle d'évaluation sans examens.

Standard level overall

Grade:	1	2	3	4	5	6	7
Mark range:	0-10	11-21	22-31	32-43	44-56	57-68	69-100

Internal assessment

The range and suitability of the work submitted

A good mix of topics from the syllabus were investigated, popular were: salinity, fertiliser & pH influence on plants, EVSs, carbon emissions, air quality and GDP. Overall a spread of methodologies, including field work, surveys, use of secondary data and lab work, with slightly more secondary data and survey based investigations. These styles of investigation are often on current popular trends in the media, covid, reduction in meat consumption & climate change etc. There are still investigations that are too simplistic to have any realistic relevance to the Environmental Issue (EI) (eg: microwaved water to model global warming).

There were quite a few practicals where students bolstered secondary data with interviews.

There are still literature review/essay style reports which do not meet some of the criteria.

An environmental issue must be the main focus for the IA as this directly impacts the marking in the CXT, DEV and APP.

Statistical analysis in surveys still weak and usually completed by the survey tool used.

This session included some interesting and original topics: Bamboo charcoal and water filtration, correlating cattle ranching and deforestation, comparing the energy sources for a building to reduce carbon emissions, looking at rules & regulations and whether these changed SDW or air pollution.

Some schools have hit on a formula in which students use large world databases to plot two variables against each other, seeking to corroborate theory, for example women's education against fertility. These secondary data practicals, really need to look at more than one database in order to check data.

Candidate performance against each criterion

Identifying the context

Most students generated RQs that were relevant to ESS and were able to link the EI to put the research question into context. Students were able to perform well in this criterion.

The RQs have improved with effective use of Binomial Nomenclature and variables often included. Inclusion of locations and timing were also seen.

Many candidates were able to discuss their EI, such as climate change, acid deposition, air pollution etc. and reference sources effectively.

Common areas of weakest are unfocused research questions, a general EI and a lack of connection between the EI and RQ.

Making a connection between the RQ and the EI is essential. For example, the RQ “what is the effect of X on germination or growth of plant seeds Y” the student needs to mention the connection between the plant species Y and the environmental issue of X. If the RQ reads, "What is the impact of acid rain on germination of legumes?" but the student is using vinegar to sprout peas the connection of vinegar to acid rain and why peas needs to be mentioned. Questions must be very specific. For example when writing about organic pollution of freshwater and the resulting consequences, students really **must** mention eutrophication.

Personal connections often drive a student's interest, this is not what is required for the third aspect. Students need to ask why they are interested in their RQ as it relates to the EI. Very often this takes the form of, "this is a global issue, and here we have a local example of the problem." Simply stating that the student is interested in the question because they live in the area, is not sufficient

Some EIs were entirely based on the impacts on human well-being rather than impacts on the environment. Examples include studies on air/noise pollution and human health.

Planning

This criterion is mostly attempted.

Often missing: the risk and ethics section, especially for secondary data collection, detail in the method to enable someone else to repeat the investigation, site selection information, chemical amounts to use, how was the survey sent out, the specifics of how a database was mined.

The sampling strategy is often described rather than justified.

Students seem more familiar with writing a plan for traditional labs or fieldwork rather than for surveys or secondary data collection. There is no need for students to include detailed instructions on how to use software or chemical testing kits.

There were a number of "at home" experiments, mostly with growing plants in different conditions, linked to COVID restrictions. These are fine, but not if the question is a query about whether some or other growing method will work. For example, the implementation of a vertical garden by itself, is not suitable.

The inclusion of methodology in an appendix is unsuitable such as survey questions or location information.

Secondary data IA reports must include the source of the data and years selected in the PLA section and not simply in the references at the end of the report. The sources of the data should be specific and verifiable. Using the complete data sets from a database does not involve sampling.

When using surveys, students must include a description of how their sample was selected. A number of students included calculations to determine the size of the sample they needed in order to adequately represent the population, and this is of course wonderful.

Results, analysis and conclusion

Many reports used an appendix for the raw data. Raw data is required in the main body of the IA report. Only having the processed data or raw data in an appendix will mean only a maximum of a 4 can be obtained. Many students are including large spreadsheets of data which are poorly presented and too small to see.

Data processing in many cases was relevant and sufficient. Many students carried out detailed statistical analyses such as Pearson's correlation coefficient, t-tests, ANOVA test, and Chi-square analysis. Students should be encouraged to do analyses that are more complex than simply calculating an average or a percent. However, a graph that shows the standard deviations for different averages as a bar graph, or a separate table with only the standard deviation is a serious error. Commenting upon the statistical test outcome for the conclusion is expected. Teachers must check the maths of the students' results sections

A perennial issue is the inclusion of tables and graphs that have been copied and pasted from the internet, and nothing further is done to the data.

Students are also still using graphs that are generated in survey forms and therefore do not show evidence for processing data (this has been flagged in many examiner reports). These graphs and pie charts usually do not address the RQ but rather just display the question answers.

The majority of the conclusions used the results and patterns shown from the investigation to answer the RQ. The better reports included reliability and validity statements as well. Some conclusions suffered from overgeneralizing. e.g. saying acid rain is damaging crops based on the results of a simulation with vinegar and peas is not supported by the experimental data.

Discussion and evaluation

The discussion component is usually the weakest and can be very brief. Students have difficulty evaluating the conclusion in the context of the environmental issue. Some students are able to do this well using supporting literature and data. The discussion should include confounding factors that strengthen or weaken the conclusion.

Discussing strengths, limitations and weaknesses of the method is addressed more thoroughly than evaluating the conclusion. Most candidates suggest one or more modifications to the method; however, few candidates suggest a modification that addresses a significant weakness with "large effect". Many students do not include information on areas of further research, or the areas suggested are superficial.

Applications

Most candidates included some form of application or solution, but often evaluation of it was superficial or not completed. Very few students justify one solution and then fully evaluate the solution.

In some secondary data practicals, such as the relationship between GDP and CO_2 emissions, it's hard for candidates to realize that they need to write about one solution and not ten or twenty. The evaluation of these solutions (when they have included many) tends to be very general and so do not score very well against the criterion. One suggestion for teachers is to have students approach this from their own agency. For example, if they are studying the impact of COVID on air pollution, what can they do as an individual to change their behaviour. For example, turning off lights in the home or placing a motion detector in a seldom used space to trigger lights. The evaluation could then include the cost of placing the detector, the inconvenience, etc.

Communication

Reports are generally well-constructed, the format is mostly organized, and appropriate terminology is reasonably well employed.

Common areas of improvement in COM are simple proofreading mistakes: Lack of labels on graph axes, inconsistent use of decimal points, inappropriate data tables.

The use of an appendix is penalised in COM.

In a few cases the scripts didn't follow the required structure having an essay form - then it is difficult to assess planning and further criteria.

Overall the vast majority of students adhered to the 2250 word count.

Recommendations and guidance for the teaching of future candidates

Ensure that no school, teacher or candidate data appears on the IA report.

Teachers and students should be informed that anything in an Appendix is not marked.

Emphasize the need to include appropriate in-text citations (academic integrity).

Students should be encouraged to reference all source material. Encourage students who want to use surveys to think about the statistical tests they can use.

More use of the IA criteria in the practical activities done before the IA investigation is started.

When teaching the use of statistics, teachers need to get students to consider why they would use each statistical method and what the results mean to their work. Where appropriate, candidates should be encouraged to go further than simply calculating averages. Ensure that students have access to a range of statistical analysis tools (at least standard deviation).

Teachers must give students support in how to develop a fully focused research question that will be able to provide sufficient data.

Students need instruction on how to construct repeatable methods when using websites, databases and questionnaires/surveys.

Fieldwork plans must include site choice information for repeatability.

Have students practice writing out methodologies to ensure that the plans are complete and repeatable to the reader.

Sampling strategy is not just about 'stratified or convenience.....' but about every part of the methodology.

All plans should have a risks and ethics section.

The use of google forms and other online survey platforms needs to be supported to allow students to process the data generated themselves. Candidates should be advised to generate their own graphs and not include only those generated by the survey.

Students should include a graph that responds directly to their RQ. This graph is frequently missing.

Bar Graphs: Teachers should instruct students that in bar graphs, unless there is an order in the horizontal axis that needs to be respected, bars should be placed in some order (e.g. largest to smallest).

Scatter plots: More and more students are including a correlation coefficient when producing scatter plots and the interpretation of these needs direct instruction so that students don't make erroneous conclusions. Students should be instructed to determine which is the independent variable and plot this on the horizontal axis.

When recording data on several different days, weeks, etc. calculating an average may be completely inappropriate. This requires direct instruction.

Standard deviations are of no benefit unless they are commented upon and used in the analysis as e.g. error bars. Students need direct instruction on what the SD means and how to use it.

Some statistical tests are being applied but the student has not or does not know how to interpret the results.

Students should be aware that they cannot use data directly from databases as their own, processed data.

Remind the students that the use of an appendix is not appropriate, this is not marked.

Students need support in how to write an evaluation of the conclusion in the discussion.

In APP more specific solutions should be stated - 'education of the population ... but how? Not just 'post things on social media' but a justification of how the social media platform will be used.

The evaluation of the solution needs to be detailed.

Students need to give an accurate word count for all words in the report. Data, citations/bibliography and figure titles do not count. Placing many words in a table for evaluation or method are still part of the overall word count.

Many of the teacher comments were very brief and did not allow the moderator to see how or why a mark was or was not awarded for a criterion.

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

Further comments

A number of essays were submitted as IAs.

Students need to be taught how to properly cite academic work using in-text citations. A bibliography list with no in-text citations is not appropriate.

Many IAs with high word counts (close to upper limit) were submitted. These should be proofread to watch for repetition.

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.

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 64% considered it to be of a similar standard, 28% believed it was more difficult and 8% 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

The requirements of command terms were sometimes mis-understood e.g. for both outline and explain, responses often lacked the necessary detail.

A significant number of students had difficulty interpreting data from the figures and applying their knowledge to the case study. This included:

- using the location map of Japan, climate graph and elevation map to identify a terrestrial biome in Hokkaido (Q1b).
- using the red-crowned crane population graph to identify the number of red-crown cranes in 1952 and 2000 (Q2ci).
- using the figure of forest stock to distinguish trends between natural forest and coniferous forest monocultures (Q3a).

The mathematical questions also proved to be difficult for many students. This included:

- calculation of average annual increase of mature red-crowned cranes between 1952 and 2000 (Q2cii).
- calculation of natural increase rate (Q4a).

Other specific aspects that appeared difficult for students included:

- evaluating the design of national parks as protected areas (Q1d).
- explaining why coniferous forest monocultures have low resilience (Q3b).
- suggesting reasons for the difference between potential and actual sources of electricity (Q5a).
- providing an explicit, balanced conclusion supported by evidence (Q6).

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

- determining annual temperature range using a climate graph (Q1a).
- outlining a relationship between location of national parks and their elevation (Q1c).
- determining the trophic level of red-crowned cranes from a figure of a simplified food web (Q2a).
- outlining the impact of Hokkaido salamander becoming extinct on the rest of the food web (Q2b).
- presenting arguments for and against Hokkaido working towards a sustainable future (Q6).

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

1a

This question was correctly answered by the majority of students.

1b

Many students struggled with this question. A common error was to respond with just 'forest' which was too vague for credit or incorrectly answer with tundra or rainforest biomes.

1c

The majority of students answered this question well.

1d

Many students did not address the question asked about the design (relating to shape, size or positioning) of the parks but instead addressed concerns over the management of the park. Overall this question was poorly answered with very few students attaining the full 4 marks.

2a

This question was well answered by the majority of students. A common error was to give generic responses such as top predator, top consumer or top of trophic level.

2b

Most students achieved some marks for this question. A common error was not to link cause and effect e.g. stating that the Japanese beetle population increased without giving the reason.

2ci

A significant number of students struggled to read the correct values from the figure which used a semi-log scale.

2cii

Many students struggled with this calculation with some students only calculating the overall change in number of red-crowned cranes between 1952 and 2000, rather than the average annual change in numbers. A significant number of students did not attempt this question.

2d

Most students achieved at least one mark with many students recognising that 'loss of habitat' was one of the criteria used by the IUCN to classify species as Endangered. A common error was to suggest genetic diversity or failure to breed in captivity were part of the IUCN criteria.

2e

Reponses varied widely for this question with some excellent responses. However, some students did not realize that moving from Endangered to Vulnerable status reflected an increase in crane numbers. Statements copied from the resource booklet were sometimes given without any explanation of their

significance to the arguments made by conservationists who disagreed with the change in status of the red-crown crane.

3a

The majority of students correctly recognised that coniferous forest monoculture was increasing at a faster rate than natural forest. However, some students did not appear to understand the concept of 'trend'. A common error was to state that there was no change in natural forest or give no direction to the change illustrated.

3b

Responses varied widely for this question. A common error was a lack of explanation e.g. many students stated that low genetic biodiversity was important but did not link this to an increased risk of disease. A significant number of students did not attempt this question.

4a

Many students incorrectly calculated the natural increase rate for Hokkaido, some did not divide their answer by 10 or recognise that the value was negative. A significant number of students did not attempt this question.

4b

Many students described the age-gender pyramid rather than addressing the question and stating the stage for Hokkaido on the demographic transition model. A significant number of students did not attempt this question.

4c

This question was well answered by many candidates. However, some responses lacked the necessary detail required and gave only a list of factors such as 'education' or 'legislation'.

5a

Responses were very mixed for this question with some very good answers. A common error was to describe the differences between potential and actual sources of electricity without giving a reason. Some students misinterpreted the data and for example suggested that actual fossil fuel use was lower than the potential.

5b

Many students gave very generalised responses that did not link the Environmental Impact Assessment (EIA) to a project or development or incorrectly thought an EIA ensured there were no impacts or damage to the environment at all.

6

Most students achieved some marks for this question and presented arguments for and against Hokkaido's sustainability. In some cases responses only focused on one or two marking points and the resource booklet was not fully utilized. In other cases, statements were copied from the resource booklet but the information was not applied to the issue of sustainability.

Overall very few students gave a well-balanced conclusion, with most conclusions being very generic and lacking the detail required for credit.

Recommendations and guidance for the teaching of future candidates

- Students should be taught 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, outline, explain, evaluate etc. Students should also know which command terms require 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 and semi-log scale 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.
- 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 avoid repeating themselves and making the same point already made within a response.
- Students should be taught to give focused answers to questions using appropriate ESS terminology. They should avoid using generalised words or phrases such as "pollution/emissions", "impacts/affects" 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 should be encouraged to take care with their handwriting during the exam to ensure that it is clearly legible. Only dark ink should be used as scripts will be scanned and marked on-screen. Students need to realize that if an answer cannot be read, it will not be marked.
- Students should be told to keep their answers within the answer box and if extra space is required, then they should 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 encouraged to attempt all questions and not leave blank responses.

Educators need to ensure the whole syllabus is covered in sufficient detail. This includes ensuring students are able to:

- interpret data and meet the mathematical requirements of the course.
- describe trends from a variety of different figures.
- identify a biome based on geographical location of the site, its topography and climate data.
- evaluate the design of a protected area.
- read data from a figure using semi-log scale.
- calculate the average annual increase in a given population.

- explain how coniferous forest monocultures have low resilience.
- calculate the natural increase rate.
- suggest reasons for differences in energy choices.

Further Comments

Teachers need to read the examiner reports as many of the same issues are being raised each year.

Schools should organise access arrangements for students with very poor handwriting (details of which can be found in the IB Access and Inclusion Policy). Non-legible handwriting appears to be getting worse each year. Handwriting skills should also be reviewed earlier on within the education sector. The use of cursive (joined-up) handwriting is appearing to make readability of scripts increasingly more difficult as these students progress through their education.

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

Paper two

General comments

Feedback from the G2 forms were largely very positive and showed satisfaction with the level of difficulty, clarity, overall quality and fairness. Some felt it was a little more difficult than previous years though this was balanced by those who felt it was a tad easier and the actual scores obtained would confirm the latter. Scores showed an appropriate distribution largely in line with previous sessions.

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

Knowledge of field techniques for comparing population density; identifying impacts of urbanisation on hydrological cycle; identifying climatic factors relevant to primary productivity; evaluating ecological footprint as a model; constructing a systems diagram to demonstrate flows of energy through ecosystem; identifying role of greenhouse effect in maintaining Earth's temperature; evaluating links between solid domestic waste disposal and mitigation of climate change; identifying ecosystem services impacted by climate change.

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

Using a dichotomous key for identification; nature of biodiversity; identifying a transformation process; calculating %; identifying causes and solutions to water stress; explaining relationship between footprints, biocapacity and sustainability; distinguishing point and non-point pollution; recent impacts on global air quality; distinguishing biotic and abiotic factors; identifying influences of value systems on resource use; explaining natural selection; links between soil fertility, photosynthesis and human activities; influences on choice of food production systems.

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

Section A

1a

Great majority could use the keys to accurately identify species.

1b

Great majority were able to suggest reasonable impacts on population density of rabbits in two habitats.

1c

Very few were able to give any detail to a description of method for comparing population density beyond mentioning quadrats (often mistakenly referred to as 'quadrants').

1d

Most were able to identify one aspect of diversity that distinguished the two habitats.

2a

Most were able to identify evapotranspiration as a transformation process.

2b

Most were able to calculate the difference in infiltration between two environments.

2c

Although majority of students identified the reason for a depleted storage, fewer identified which storage that was.

2d

Great majority knew how to calculate % decrease, but a significant number failed to read values accurately from graph.

2e

Most were able to suggest a reason for reduced water use in agriculture.

2f

Most were able to suggest increased population as a cause of increased water use, but few could come up with a second reason.

2g

Most were able to suggest two strategies to increase water supply.

3a

Vast majority were able to identify region with lower ecological footprint.

3b

Most could explain why a higher ecological footprint is unsustainable.

3c

There was some ambiguity in the wording of this question which confused some candidates and hence it was excluded in the context of grade awarding.

3d

Many candidates were unable to clearly identify how a climatic factor may limit photosynthesis.

3e

Most candidates recognised the value of ecological footprints as indicators of sustainability but few went any further than that.

Section B

4a

Most candidates were able to accurately distinguish between point and non-point source pollution but did not always come up with valid examples.

4b

A large proportion of candidates were able to describe relevant pollution management strategies although some accounts were rather vague.

4c

This was generally well-answered with many candidates giving well-balanced responses addressing how air quality has been both negatively and positively influenced by human activities.

5a

Many candidates scored full credit for this question with a sound grasp of the distinction between biotic and abiotic factors.

5b

Great majority of candidates failed to gain much credit for this question. They were unable to produce a simple systems diagram of energy flow, occasionally giving a diagram of the hydrological cycle instead, which was irrelevant.

5c

Most candidates had a reasonably sound grasp of environmental value systems and could suggest valid influences they might have on resource use.

6a

This was the question where the perennial confusion over ozone and global warming came up with many candidates suggesting ozone depletion as a cause of warming. Few could give an accurate explanation of the greenhouse effect.

6b

Most were able to describe processes of managing solid domestic waste but did not always link this effectively with mitigating climate change. For example, the great majority described landfill use which has no real influence in mitigation.

6c

While the great majority had a clear idea of many impacts of climate change, few were able to grasp the concept of ecosystem services which left their responses only partially relevant.

7a

Most were able to identify key processes in the mechanism of natural selection.

7b

The majority were able to identify some link between soil fertility, productivity and human activities but failed to gain full credit through limited details of the relevant links.

7c

Most were able to give a range of influences on choice of food production systems though struggled to make clear distinction between social, cultural, political and economic influences.

Recommendations and guidance for the teaching of future candidates

As usual, we had hints of the confusion that regards ozone depletion and UV radiation as the cause of global warming. Fortunately, in this exam, not many marks were at risk from the confusion, but it remains an earnest hope that the matter could be cleared up once and for all in the minds of candidates.

There are still a few stragglers who seem not to give due heed to the number of marks awarded per question, and satisfy themselves with single or abbreviated responses when a great deal more credit is available. Nevertheless, this refers to a declining proportion of candidates and overall it seems that candidates are being well prepared in a strategic approach to examinations.

The most glaring gap in students' preparation for this exam was the inability to produce a systems diagram of energy flow in the ecosystem. This is really a fundamental aspect of understanding ecosystems and the overall approach of the syllabus and clearly needs more careful attention.