Criterion A: One world

Maximum: 6

One world enables students to gain a better understanding of the role of science in society and allows them to explore how scientific developments and applications are applied and used to address specific problems or issues in local and global contexts.

Students should be able to:explain the ways in which science is applied and used to address **a specific** problem or issued, discuss the effectiveness of science and its application in solving the problem or issue,discuss and evaluate the moral, ethical, social, economic, political, cultural and environmental implications of the use of science and its application in solving specific problems or issues.

Assessment tasks should give students the opportunity to explore how science is used to address **a specific** problem or issue. Students are required to critically discuss and evaluate the implications associated with the use and application of science by considering moral, ethical, social, economic, political, cultural and environmental factors.

Suitable assessment tasks for criterion A include written pieces of work, essays, case studies and research projects, as well as debates, oral and multimedia presentations.

Achievement level	Level descriptor
0	The student does not reach a standard described by any of the descriptors below.
1–2	The student **states** how science is applied and how it may be used to address a specific problem or issue in a local or global context. The student **states** the effectiveness of science and its application in solving the problem or issue.
3–4	The student **describes** how science is applied and how it may be used to address a specific problem or issue in a local or global context. The student **describes** the effectiveness of science and its application in solving the problem or issue. The student **describes** the implications of the use and application of science interacting with **at least one** of the following factors: moral, ethical, social, economic, political, cultural and environmental.
5–6	The student **explains** how science is applied and how it may be used to address a specific problem or issue in a local or global context. The student **discusses** the effectiveness of science and its application in solving the problem or issue. The student **discusses and evaluates** the implications of the use and application of science interacting with **at least two** of the following factors: moral, ethical, social, economic, political, cultural and environmental.

Describe: to give a detailed account.

Discuss: to give an account including, where possible, a range of arguments for and against the relative importance of various factors and comparisons of alternative hypotheses.

Evaluate: to assess the implications and limitations.

Explain : to give a clear account, including causes and reasons or mechanisms.

State: to give a specific name, value or other brief answer without explanation or calculation.

Criterion B: Communication in science

Maximum: 6

Communication in science enables students to develop the communication skills to become competent and confident when communicating information in science.

Students should be able to use different communication modes, including verbal (oral, written) and visual (graphic, symbolic), as well as appropriate communication formats (laboratory reports, essays, and multimedia presentations) to effectively communicate scientific ideas, theories, findings and arguments in science.

Students should be able to: use scientific language correctly,use appropriate communication modes and formats, acknowledge the work of others and the sources of information used by appropriately documenting them using a recognized referencing system.

Suitable assessment tasks for criterion B include scientific investigation reports, research essays, case studies, written responses, debates and multimedia presentations among others.

Achievement level	Level descriptor
0	The student does not reach a standard described by any of the descriptors below.
1–2	The student uses a **limited range** of scientific language **correctly**. The student communicates scientific information with **limited effectiveness**. When appropriate to the task, the student **makes little attempt** to document sources of information.
3–4	The student uses **some** scientific language correctly. The student communicates scientific information with **some effectiveness**. When appropriate to the task, the student **partially documents** sources of information.
5–6	The student uses **sufficient** scientific language correctly. The student communicates scientific information **effectively**. When appropriate to the task**,** the student **fully documents** sources of information **correctly**.

Document: to credit fully all sources of information used by referencing (or citing), following one recognized referencing system. References should be included in the text and also at the end of the piece of work in a reference list or bibliography.

Notes

The first strand of the criterion requires students to use scientific language correctly. Teachers are expected to determine within the context of the task what constitutes acceptable evidence for "limited range", "some" and "sufficient" scientific language and communicate this to students.

Effective communication in this context implies that the work achieves what it intends to, including being successful and convincing, well structured and presented in a logical sequence, and supported by evidence as appropriate. It involves the use of appropriate communication modes and formats to communicate scientific ideas, theories or findings to a particular audience in a successful way.

Criterion B can be used with a range of tasks such as written pieces of work as well as oral and multimedia presentations. In all cases students are expected to acknowledge the work of others and the sources of information used by referencing (or citing). The IB does not prescribe any particular referencing system. Schools are allowed to follow a recognized referencing system of their choice in a consistent manner.

The statement "when appropriate to the task" means that, depending on the nature of the tasks (and generally for written pieces of work), students are required to fully document the sources used.

Criterion C: Knowledge and understanding of science

Maximum: 6

Knowledge and understanding of science enables students to demonstrate their understanding of science by applying scientific knowledge to construct scientific explanations, solve problems and formulate scientifically supported arguments.

Students should be able to:recall scientific knowledge and use scientific understanding to construct scientific explanations, apply scientific knowledge and understanding to solve problems set in familiar and unfamiliar situations, critically analyse and evaluate information to make judgments supported by scientific understanding.

Suitable assessment tasks for criterion C include tests, examinations, case studies, written responses and other assignments that combine a range of problems of different complexity, and opportunities for students to makes scientifically supported judgments.

Achievement level	Level descriptor
0	The student does not reach a standard described by any of the descriptors below.
1–2	The student **recalls some** scientific ideas, concepts and/or processes. The student applies scientific understanding to solve **simple problems**.
3–4	The student **describes** scientific ideas, concepts and/or processes. The student applies scientific understanding to solve **complex problems in familiar situations**. The student **analyses** scientific information by identifying parts, relationships or causes.
5–6	The student **uses** scientific ideas, concepts and/or processes **correctly** to **construct scientific explanations**.

	The student applies scientific understanding to solve complex problems **including** those in **unfamiliar situations**. The student **analyses** and **evaluates** scientific information and **makes judgments supported by scientific understanding**.

Analyse: to identify parts and relationships and to interpret information to reach a conclusion.

Complex problems: refers to problems that are set in a familiar or unfamiliar context and require analysis. These problems can often be broken down into sub-problems or stages, each of which requires the selection and application of the appropriate principle, rule, equation or method.

Evaluate: to assess the implications and limitations; to make judgments about the value of ideas, works, solutions and methods in relation to selected criteria.

Simple problems: refers to straightforward problems that are clearly stated and set in a familiar context, and require the student to apply the appropriate principle, rule, equation or method.

Unfamiliar situation: refers to a problem or situation in which the context or the application is modified so that it is considered unfamiliar for the student.

Notes

The first strand of the criterion refers to students using scientific knowledge. It requires students to "recall/describe/use scientific ideas, concepts and/or processes". However, this list is not exclusive and may also include scientific models, laws, principles and theories as appropriate to the task.

To reach the highest level of the criterion, students are required to make scientifically supported judgments about the validity and/or quality of the information presented to them. For this purpose assessment tasks could include questions dealing with "scientific claims" presented in media articles (newspapers, television, the internet, and so on), or the results and conclusions from experiments carried out by others, or any question that challenges students to critically analyse and evaluate the information and that allows them to formulate arguments about its validity and/or quality using their knowledge and understanding of science.

Criterion D: Scientific inquiry

Maximum: 6

This criterion enables students to design and carry out scientific investigations independently.

Students should be able to: state a focused problem or research question to be tested by a scientific investigation,formulate a testable hypothesis and explain it using scientific reasoning,design and carry out scientific investigations that include variables and controls, material and/or equipment needed, a method to be followed, and the way in which the data is to be collected and processed, evaluate the validity and reliability of the method, judge the validity of the hypothesis based on the outcome of the investigation, suggest improvements to the method or further inquiry, when relevant.

Suitable assessment tasks for criterion D should provide students with the opportunity to design and carry out a scientific investigation independently. Some of the possible types of suitable practical work include laboratory experiments, investigations and field studies among others.

Achievement	Level descriptor

level	
0	The student does not reach a standard described by any of the descriptors below.
1–2	The student **attempts to state** a focused problem or research question. The method suggested **is incomplete**. The student **attempts to evaluate** the method and respond to the focused problem or research question.
3–4	The student **states** a focused problem or research question and **makes a hypothesis** but **does not explain it** using scientific reasoning. The student selects **appropriate** materials and equipment and writes a **mostly complete** method, mentioning **some of the variables** involved and how to manipulate them. The student **partially evaluates** the method. The student **comments** on the validity of the hypothesis based on the outcome of the investigation. The student **suggests some** improvements to the method or makes suggestions for further inquiry when relevant.
5–6	The student states a **clear** focused problem or research question, **formulates a testable hypothesis** and **explains** the hypothesis using scientific reasoning. The student selects appropriate materials and equipment and writes a **clear**, **logical** method, mentioning **all of the relevant variables** involved and how to control and manipulate them, and describing how the data will be collected and processed. The student **evaluates** the method, commenting on its **reliability** and **validity**. The student comments on the validity of the hypothesis based on the outcome of the investigation. The student suggests **realistic** improvements to the method and makes suggestions for further inquiry when relevant.

Explain: to give a detailed account of causes, reasons or mechanisms.

Reliability of the method: refers to whether the method allows for the collection of sufficient reliable data to answer the question. This depends upon the selection of the measuring instrument, the precision and accuracy of the measurements, errors associated with the measurement instrument, the size of the sample, the sampling techniques used and the number of readings.

Validity of the method: refers to whether the method allows for the collection of sufficient valid data to answer the question. This includes factors such as whether the measuring instrument measures what it is supposed to measure, the conditions of the experiment and the manipulation of variables (fair testing).

Notes

To explain the hypothesis using scientific reasoning requires students to include in their explanations the scientific concepts, theories or understanding that support their thinking of why or how something might happen the way they have hypothesized or predicted.

When designing a scientific investigation, students should develop a method that will allow them to collect sufficient data so that the research question can be answered and the reliability of the data evaluated.

To allow students to develop scientific investigations independently teachers must ensure that they provide students with an open-ended problem to investigate. An open-ended problem is one that has several independent variables from which students can/could choose one as a suitable basis for the investigation. This should ensure that students formulate a range of plans and that there is sufficient scope to identify both independent and controlled variables. To ensure that the task is appropriate for the assessment of criterion D, teachers should not give students closed or very directed experiments, where the focused problem or research question and relevant variables are given.

Criterion E: Processing data

Maximum: 6

Processing data refers to enabling students to organize, process and interpret quantitative and qualitative data.

Students should be able to: collect and record data using units of measurement as and when appropriate, rganize, transform and present data using numerical and visual forms, analyse and interpret the data, draw conclusions consistent with the data and supported by scientific reasoning.

Suitable assessment tasks for criterion E include scientific investigations carried out by students, as well as laboratory reports and studies that provide students with sufficient raw data for processing and further analysis.

Achievement level	Level descriptor
0	The student does not reach a standard described by any of the descriptors below.
1–2	The student **collects some** data and **attempts to record** it in a suitable format. The student **organizes and presents** data using **simple** numerical **or** visual forms. The student **attempts to identify** a trend, pattern or relationship in the data. The student attempts to draw a conclusion but this is **not consistent with** the interpretation of the data.
3–4	The student collects **sufficient** relevant data and **records** it in a suitable format. The student organizes, **transforms** and presents data in numerical and/or visual forms, **with a few errors or omissions** . The student **states** a trend, pattern or relationship shown in the data. The student draws **a conclusion consistent with** the interpretation of the data.

5–6	The student collects sufficient relevant data and records it in a suitable format. The student organizes, transforms and presents data in numerical and/or visual forms **logically** and **correctly**. The student **describes** a trend, pattern or relationship in the data and comments on the reliability of the data. The student draws a **clear** conclusion **based on** the **correct interpretation** of the data and **explains it** using scientific reasoning.

Numerical forms: may include mathematical calculations such as averaging, or determining values from a graph or table.

Qualitative data: refers to non-numerical data or information that it is difficult to measure in a numerical way.

Quantitative data: refers to numerical measurements of the variables associated with the investigation.

Transforming data: involves processing raw data into a form suitable for visual representation. This process may involve, for example, combining and manipulating raw data to determine the value of a physical quantity (such as adding, subtracting, squaring or dividing), and taking the average of several measurements. It might be that the data collected is already in a form suitable for visual representation, for example, distance travelled by a woodlouse. If the raw data is represented in this way and a best-fit line graph is drawn, the raw data has been processed.

Suitable format: may include tables with appropriate headings and units, large clearly labelled diagrams or concisely worded observations.

Visual forms: may include drawing graphs of various types appropriate to the kind of data being displayed (line graphs, bar graphs, histograms, pie charts, and so on).

Notes

Suitable assessment tasks can include scientific investigations carried out by students where students collect and record raw data for themselves, as well as data from investigations carried out by others (generally data from scientific articles in journals, books or the internet). When students are provided with the data by the teacher, the first strand (sentence) of the descriptor that refers to data collection should not be considered for assessment. Also, students are not expected to comment on the reliability of the data because they would not have enough information to make judgments about the uncertainties incurred during the experiment (such as the choice of measuring instrument, precision and accuracy of the measurements, errors associated with the measurements, number of readings, size of the sample, sampling techniques used and so on).

Assessment tasks where the data is provided in preformatted tables with columns, headings and units of measurement are unlikely to allow students to reach the highest level of achievement for this criterion.

Criterion F: Attitudes in science

Maximum: 6

Attitudes in science encourages students to develop safe, responsible and collaborative working practices when carrying out experimental work in science.

During the course students are expected to: work safely and use material and equipment competently, work responsibly with regards to the living and non-living environment, work effectively as individuals and as part of a group by collaborating with others.

Evidence of performance for this criterion should be collected from the observation of students when working individually and in groups. This criterion should be internally assessed but is not externally moderated.

Achievement level	Level descriptor
0	The student does not reach a standard described by any of the descriptors below.
1–2	The student **requires some guidance** to work safely and **some assistance** when using material and equipment. The student requires **some guidance** to work responsibly with regards to the living and non-living environment. When working as part of a group, the student needs **frequent reminders to cooperate with others**.
3–4	The student **requires little guidance** to work safely and **little assistance** when using material and equipment. The student **works responsibly** with regards to the living and non-living environment. When working as part of a group the student **cooperates with others on most occasions**.
5–6	The student **requires no guidance** to work safely and uses material and equipment **competently**. The student works responsibly with regards to the living and non-living environment. When working as part of a group, the student **cooperates with others**.