

# Guidance on the IA Criteria

## Planning (a)

It is generally not appropriate to assess *planning (a)* for most experiments or investigations found in standard textbooks, unless the experiments are modified. It is essential that students are given an open-ended problem to investigate. Although the general aim of the investigation may be provided by the teacher, students must be able to identify a focused problem or specific research question.

For example, the teacher might present the aim of the investigation generally in the form "investigate the factors that affect X". Students should be able to recognize that certain factors will influence X and clearly define the aim of the experiment or identify a focused research question. A hypothesis or prediction should then be formulated in the light of any independent variables that have been chosen. Such a hypothesis must contain more than just an expected observation. It must include a proposed relationship between two or more variables, or at least an element of rational explanation for an expected observation, the basis of which can be investigated experimentally. A typical formulation for a hypothesis might be "if y is done, then z will occur". Other variables that might affect the outcome should also be mentioned, even if they are not to be specifically investigated. Controlled variables should also be selected.

## Planning (b)

The student must design a realistic and appropriate method that allows for the control of variables and the collection of sufficient relevant data. The experimental set-up and measurement techniques must be described.

## Data Collection

Data collection skills are important in accurately recording observed events and are critical to scientific investigation. Data collection involves all quantitative or qualitative raw data, such as a column of results, written observations or a drawing of a specimen. Qualitative data is defined as those observed with more or less unaided senses (colour, change of state, etc) or rather crude estimates (hotter, colder, etc), whereas quantitative data implies actual measurements.

Investigations should allow students opportunities to deal with a wide range of observations and data. It is important that the practical scheme of work includes:

- the collection of qualitative and quantitative data
- various methods or techniques
- different variables (time, mass, etc)
- various conditions
- subject-specific methods of collection.

In addition:

- attention to detail should be reflected in the accuracy and precision of the data recorded
- use of data collection tables should be encouraged
- methods of collection and the measurement techniques must be appropriate to each other
- units of measurement must be relevant to the task at hand.

## **Data Processing and Presentation**

The practical scheme of work should provide sufficient investigations to enable a variety of methods of data processing to be used.

Students should also be exposed to the idea of error analysis. That is not to say that error analysis must be carried out for every investigation, nor should it overshadow the purpose of an investigation.

Students should show that they can take raw data, transform it and present it in a form suitable for evaluation.

Processing raw data may include:

- subjecting raw data to statistical calculations (eg producing percentages or means), with the calculations correct and accurate to the level necessary for evaluation
- converting drawings into diagrams
- converting tabulated data into a graphical form
- correctly labelling drawings
- sketching a map from measurements and observations in land form
- proceeding from a sketched idea to a working drawing (eg orthographic projection or sectional views).

The data should be presented so that the pathway to the final result can be followed. Features which should be considered when presenting data include:

- quality of layout (eg choice of format, neatness)
- choice of correct presentation (eg leave as a table, convert to a graph, convert to a flow diagram)
- use of proper scientific conventions in tables, drawings and graphs
- provision of clear, unambiguous headings for drawings, tables or graphs.

## Conclusion and Evaluation

Once the data has been processed and presented in a suitable form, the results can be interpreted, conclusions can be drawn and the method evaluated.

Students are expected to:

- analyse and explain the results of experiments and draw conclusions
- evaluate the results.

Analysis may include comparisons of different graphs or descriptions of trends shown in graphs.

Students are also expected to evaluate the procedure they adopted, specifically looking at:

- the processes
- use of equipment
- management of time.

Modifications to improve the investigation should be suggested.

## Manipulative Skills

Indications of manipulative ability are the amount of assistance required in assembling equipment, the orderliness of carrying out the procedure(s), the ability to follow the instructions accurately and adherence to safe working practices.

## Personal Skills (a)

Working in a team is when two or more students work on a task collaboratively, face-to-face, with individual accountability. Effective teamwork includes recognizing the contributions of others, which begins with each member of the team expecting every other member to contribute. The final product should be seen as something that has been achieved by all members of the team participating in the tasks involved. Encouraging the contributions of others implies not only recognizing, but also actively seeking, contributions from reluctant or less confident members of the team.

## Personal Skills (b)

Issues such as plagiarism, the integrity of data collection and data analysis, may be considered here. Sources of data should be acknowledged and data must be reported accurately, even when anomalous or when an experiment has not given rise to the results expected. Due attention to environmental impact may be demonstrated in various ways including avoidance of wastage, using proper procedures for disposal of waste, and minimizing damage to the local environment when conducting experiments.

# Assessing an Investigation

In assessing an investigation it must be noted that:

- the same standards must be applied to both HL and SL students
- level 3 does not imply faultless performance
- only whole numbers should be awarded, not fractions or decimals.

The work being assessed must be that of the student. For example in work on *planning (a)*, the student should define the problem, formulate the hypothesis and select the variables; this information should not be provided by the teacher. In work on *data collection*, the student must decide how to collect, record, organize and present the raw data. The teacher should not, for instance, specify how the data should be acquired or provide a table in which the data is recorded. This principle extends to the other criteria.

To illustrate the use of the achievement level matrixes, consider the following example. A student's work is assessed against the criterion *data processing and presentation*. The teacher feels that the first aspect, *processing raw data*, is met completely whereas the second aspect, *presenting processed data*, is only achieved partially. Using the achievement level matrix for *data processing and presentation*, this translates to a level of 2.