

Appendix 1

Advanced Higher Biology Investigation

December 2004

Outcome 1 (O1) Develop a plan for an investigation

Evidence seen at moderation showed a general lack of planning which often led to unstructured experimental work and wasted time. Guidance by class teachers at the planning stage can focus a candidate's thinking and aid final evaluation. Planning is a skill which must be developed and attention to the performance criteria should help structure the process.

The following points might be useful as a breakdown of the planning activity.

Plan

- (1) Formulation of an initial aim and hypothesis or/questions relevant to the aims to include ideas and reasons for study.

A statement of the initial aim and hypothesis/questions should be made before the start of the practical work. These may be modified as the work progresses working up to an overall aim which may bring together a series of related practicals. Clarity in setting out the aims is crucial to the success of the investigation since many marks in the course report relate to the aims ie procedures, conclusions and evaluation.

- (2) Background research; list of resources consulted noted in the daybook.

Initial background reading should help focus the candidate in their investigations to decide 'Why is this worth studying?' ie consideration should be given to the biological significance of the investigation at the planning stage. This will help with the formulation of more specific aims and lead to more appropriate evaluations in the course report.

- (3) Consideration of possible options and reasons for selection of techniques/procedures.

Candidates should be encouraged to evaluate any given protocols and to consider the validity of techniques and procedures in relation to the intended aims of the investigation. Limitations in techniques and procedures should be considered and suitable controls built in and/or amendments made.

- (4) Justification of experimental procedures in relation to the initial aim, eg

- ◆ What is being measured and how?
- ◆ Do the techniques measure what is intended?
- ◆ What variables have to be controlled?
- ◆ How can validity of procedures be measured?
- ◆ What potential errors may be generated and how can they be minimised?
- ◆ How many replicates are required?

The need for replicates should move on from the Higher LO3 point of mean values being more reliable than an individual result to the idea that replicate treatments should produce identical results. Candidates should appreciate that validity and reliability are compromised if there are no replicates and controls. 'Lack of time' is not an acceptable excuse as this would constitute a design flaw that should have been spotted, discussed and amended in early meetings with the candidate.

- (5) Lists of experimental, observational and sampling procedures, techniques and apparatus to be used.

These should be detailed in full so that candidates can develop an appreciation of the principles behind the techniques and procedures. Again careful consideration at the planning stage will help candidates build in appropriate design features into their investigations.

- (6) Resources; availability, cost and source of materials and chemicals.
- (7) Safety issues.
- (8) Timescale.

At the planning stage teachers/lecturers should encourage candidates to think the investigation through in relation to other factors which might influence the results:

- ◆ rate of diffusion (size/shape/concentration) /toxicity affects the spread of materials from wells cut in agar
- ◆ osmotic effects due to different concentrations will affect growth rates in water cultures
- ◆ other factors may influence recovery time when investigating effect of high energy drinks

The help of teachers/lecturers should be sought as the plan takes shape and the support/suggestions given should be recorded. The daybook should show progression, i.e. evidence of modification of the plan as a result of discussions/initial experiments/unexpected results/problems encountered. There may well be further discussion and feedback with the teacher/lecturer which may lead to a revised aim and further experimentation. Help freely given, accepted and acknowledged at this stage will provide a firm foundation on which the candidate can build when they write their final, individual report.