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Moderators' Report/ Principal Moderator Feedback

June 2011

GCE Biology (6BI06)
Practical Biology and Investigative Skills

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Examiners' / Moderators' Report – June 2011

General Comments

The comments contained in this report apply to both internal assessment 1A and external assessment 1B.
To ensure consistency of standards a common team of examiners undertook both moderation and assessment.
Many of the comments here are similar to those made in the examiners' report June 2010 and therefore some exemplification is also included.
Centres are strongly recommended to consult the exemplar material published in Dec 2010 and available at
https://www.edexcel.com/migrationdocuments/secure_content%20general/All%20UK%20and%20All%20International%20secure%20content%20A_AIN_0%20A_AUK_0/Unit-6-Exemplar-v3.pdf
This was compiled from evidence provided by the first candidates sitting this paper in June 2010 and is therefore a better reflection of current practice when placed alongside this report.
Once again there was a wide range of interesting laboratory and field based investigations and it was encouraging to note that there was some evidence that the important omissions noted in June 2010 had been addressed by most candidates. However, many centres opting for internal assessment and moderation (1A) still found it difficult to apply the criteria in the rigorous hierarchical manner adopted by moderators and there were some significant differences.

How examiners and moderators apply the criteria.

- In many criteria there are quality judgements to be made not simply awarding a mark on the basis of minimal evidence in the report.
- The report must provide evidence of the individual HSW skills of the candidate.
- All sub-sections of each criterion must be assessed separately before an overall mark range can be awarded. Only in this way can the hierarchical rule be applied. (ALL sub-sections must meet the requirements of that mark level before it can be considered)

Where internally assessed marks were generous it was common to find an overall mark for that criterion without a detailed breakdown, to indicate that the hierarchical rules had been applied, or simply accompanied by a quote from the criteria.

Choice of investigation titles

There was no evidence that choosing laboratory based investigations or fieldwork was more likely to lead to high marks. Choice of investigation was far less important than the manner in which candidates approached the task. There were many examples of similar topics producing very high and very low marks. It is important to stress, once again, that examiners and moderators assume that the record of assessment of practical skills for each candidate confirms that they have looked at all the core practicals in some

detail. Hence, candidates choosing to submit very similar investigations need to use these techniques in such a way as to provide further evidence of their individual ability rather than simply following a fixed protocol.

e.g.
Testing the effect of various mouthwashes, handwashes or 'essential' oils on bacteria using the standard bacterial lawn core practical.
Candidates often repeated the standard technique without further trials or thought about important variables, such as exactly what to measure and why. The biggest problem was often the lack of any sound scientific reasoning. Most did not even consider the contents of what they were testing or how the comparisons they were making might be scientifically valid. They often confounded this by using scientifically unrecognised claims about various extracts from weak sources. This meant that high marks for these were less common.
Germination and growth investigations
A number of candidates investigating these topics did so in a very simplistic manner often simply growing cress seeds in petri dishes. There was often a lack of A2 level understanding with 'growth' and 'germination' being treated as synonymous, comments on rates which were not measured and a failure to understand the role of the energy reserves within the seeds themselves.
Effects of caffeine investigations
The effect of caffeine on reaction time and memory are popular titles. Some are planned and executed well but many are limited. It would be helpful to remind candidates that sources of caffeine such as 'Red Bull' contain several active ingredients which severely limit the conclusions that can be made about caffeine. Similarly vague assurances about 'telling the subjects not to consume caffeine for 12 hours' are scientifically dubious. The BBC programme 'Sheep Run' is a popular choice for reaction timing but very few candidates consider exactly what sensory and motor activity this is actually testing. In the weakest examples there is limited evidence of practical skill other than collecting data from a selected group in the school computer room.

Fieldwork and Field Centres

There were many excellent and well-organised fieldwork investigations but a number of centres submitted reports which reflected a strongly directed approach in which it was very difficult for examiners/moderators to ascertain the contribution of individual candidates, especially to the planning process.
Most field centres offer excellent access to interesting biological habitats along with professional support. However, it is the responsibility of the teacher to ensure that they are fully aware of the requirements of this specification and the need to allocate sufficient time to meaningful trial investigations.
The examiners understand the time constraints on centres when organising field work and the need to utilise late summer or early autumn. However, no allowance can be made for candidates attempting Unit 6 at the end of their AS year. Centres following this pattern are recommended to ensure that candidates undertaking this at such an early stage have received sufficient training in the difficult skills required.

A random list illustrating the range of investigations submitted is given at the end of this report. These are not meant as 'recommended' investigations but are illustrative of the range of ideas presented.

Research &rationale

R(a) The large majority of candidates found some biological background to include in this section but linking this clearly to the actual hypothesis was much more variable. Even where there was some very good detail using reliable sources it was not always used to explain the possible link between the variables investigated. This was particularly true of some ecological investigations where details of individual organisms were often impressive but a wider consideration of the ecological reasons behind their distribution was ignored. Many investigating the effect of light on distribution gave detailed accounts of the biochemistry of photosynthesis with little regard to the fact that this would equally affect all green plants. Examiners are also looking for some brief rationale here to explain why the proposed investigation might be of interest to biologists or other scientists. This was sometimes ignored and made the award of the higher mark ranges difficult. This section provides evidence of candidates ability to research scientific information and hence references which are simply common school texts are given very limited credit.

An example of a simple rationale

These antioxidants protect cells from free radicals within the body that can lead to blood clots formations and atherosclerosis.(3) The antioxidant flavonols may also help decrease the levels of low density lipoprotein (LDL) cholesterol within the body while increasing the high density lipoprotein (HDL). This will reduce the risk of heart disease in an individual which can also be reduced by the reduction of caffeine intake.

This is why I decided to investigate both caffeinated and decaffeinated tea as it is suggested that decaffeinated has a potential for more health benefits. However some studies have indicated that decaffeinated green tea contains fewer antioxidants than caffeinated due to the decaffeination process (4), the green tea looses a third to half of the original antioxidants.

Comment The second paragraph links well to the researched information and begins to explain, again with a supporting reference, why this might be a relevant investigation to attempt.

R(b) There was a significant increase in the use of researched information to help explain the data in I(b) but this must be clearly identified in that section to support higher marks.

Planning

This is a key criterion where evidence for HSW skills is expected. High marks cannot be supported where there is little evidence of individual thought and over-reliance on a fixed procedure. In extreme cases this resulted in identical 'trials' leading to identical methods for many.

P(a) A large majority of candidates were able to identify all of the important variables that might affect their investigation but fewer were able to give details of exactly how the most important ones were to be controlled or measured reliably.
P(b) The risk assessment was rarely a limiting factor in this section.
P(c) The most important feature of this sub-section is that the trial 'is used to inform the planning'. In many reports it was difficult to find this link.

An example of a weak trial Investigating a relationship between fleabane and soil moisture.

Distance away from pond (M)	Moisture % (1 decimal place)	Number of fleabane
0	7.3	0
5	6.0	0
10	5.8	1
15	3.3	4

My preliminary results show that as the moisture % decreases the amount of fleabane increases. This is a relationship which gives me a reason to investigate my experiment further to see if the relationship is significant.

Modifications to the method

During my preliminary test I found a relationship between my two variables so therefore will be continuing my investigation. However, I have changed various aspects of my method to achieve more accurate results.

- *Firstly I will be taking soil moisture % and number of fleabane every 1 meter instead of every 5 meters. This will allow me to collect 16 sets of data and give me a better range of results.*
- *Secondly I will be taking my soil moisture % readings 3 times at every meter. This will allow me to calculate an average soil moisture % reading making the results more precise and reliable as it will reduce the chance of anomalous results.*

Comment – The 'trial' is really initial data collection and seems to suggest that if it did not show the expected answer then the investigation would be changed! The modifications do not follow from the trial. They are simply theoretical planning issues.
Opportunities for a genuine trial – Is there a moisture gradient? How far does this extend? Is it better to count the plants or assess their % cover. Are there any other site features that might introduce other variables? Etc.

Example of a simple but improved trial - Investigating oxidation effects on yoghurt

Results of the resazurin test

Length of time yoghurt has been open for (hours)	***Type of yoghurt***	***Colour the yoghurt appears after the trial***
0.5	*Yeo Valley*	*White*
0.5	*Activia*	*White*
1.5	*Yeo Valley*	*White*
1.5	*Activia*	*Pink/ White*
2.5	*Yeo Valley*	*Pink*
2.5	*Activia*	*Pink/ White*

After 3 hours the sample was still only a white/ light pink colour and so I concluded that the method wasn't working as it failed to change to any other colour, such as violet, at any point throughout the trial.

As a result my method needed to be changed in order to find a valid and accurate way of investigating how microbial activity in yoghurt changes in response to exposure to oxygen.

Trial 2-

As discussed in the Research and Rationale, Lactobacillus bulgaricus and Streptococcus thermophilus are lactobacillus bacteria meaning that they convert lactose into lactic acid. Therefore the volume of lactic acid found in the yoghurt will indicate the level of microbial activity. As a result I used a method which would enable me to measure the strength of lactic acid in the yoghurt, in order to determine the change in microbial activity. The aim of this trial was to decide how long I should leave the yoghurt open for in order to see a large enough change in microbial activity. Additionally I needed to judge if my method worked precisely and accurately enough, allowing me to make any adjustments where necessary in preparation for the main investigation.

Comments- Here we have trials concerned with the most important variable to be measured. Problems with resazurin are identified and alternatives tried. This was continued to provide evidence of a test titration and that several hours were needed to provide meaningful data. With this type of detailed supporting evidence the higher mark ranges can be accessed

Observing

O(a) This section was generally addressed well providing the data was a 'suitable range' and indicated some attention to 'precision and repeatability'.

O(b) This was often the limiting section of this criterion. Once again examiners and moderators were looking for a sound scientific approach which was appropriate in the context of the data displayed. It is not a requirement for high marks that anomalies must be found! However it is a requirement that there is some comment showing the reasoning behind any decision. Therefore candidates are expected to explain briefly why they consider that there is no anomalous data. Where there are obvious anomalies and no comment has been made then the maximum mark

available is O3. Where anomalies are identified but there is no action or explanation then a maximum of O6 is appropriate. To achieve O(c) 7-9 then anomalies must be investigated preferably at the data collection stage. Where the nature of the investigation makes this very difficult then we would expect a detailed explanation of how the data has been adapted and why.
Some candidates were able to explain their anomalies with reference to standard deviations but others simply resorted to removing their highest and lowest values with no logical reason.

Interpreting

This is a challenging criterion which has demanding sub-sections and discriminates higher ability candidates well. Objective evaluation for I(c) was often very superficial and would be a useful emphasis for many when carrying out core practicals.
I(a) Apart from candidates who collected data without consideration of how it was to be analysed, this was a high scoring section. It is a requirement that there is some evidence of individual processing such as a table of ranks or tabulating the data in a suitable format for a t-test even though final calculations may be computer based.
I(b) Compared to June 2010 there were less omissions seen in this sub-section. Most candidates attempted to use their researched biological information to explain their collected data. Weaker candidates tended to simply reiterate information from their introductions rather than link it carefully to an interpretation of their own data.
I(c) This was often a significant limiting factor for Interpreting marks. Whilst objective evaluation is undoubtedly a difficult skill many reports showed little appreciation of the requirements of this skill or the use of evidence from their data for analysis rather than assertion. Despite the fact that many reports were well over the recommended word limit, this section and I(b) were often very brief and superficial which contrasted sharply with Research & rationale which was often long and not always relevant.

An example of a very basic evaluation – using a core practical technique to investigate the effects of silver ions on bacteria
Sources of error – limitations of the method
The biggest source of error in this investigation would be when diluting the solutions. This is because the solutions were diluted within a measuring cylinder. This is very inaccurate, meaning the concentration will be different from the desired value. To overcome this error, a volumetric flask should be used to dilute the solutions. However this will result in much leftover solutions as only very small quantities of solutions are needed to be absorbed by the assay paper discs. Another source of error would be when measuring the zone of inhibition. This is because it is very unlikely that there will be an even zone of inhibition. When each zone is measured, it will be measured differently from the zone before it. The diameter of each zone should be measured where the inhibition is even and there are no leaks. Also instead of the diameter, the area of the zone of inhibition could be measured, which would avoid the errors due to the leaks.
Improvements/suggested further work – limitations of the results

In this investigation, only one type of bacteria was used. There is no evidence from just this investigation, that these results can be applied to other bacteria. Therefore the investigation should be repeated on different bacteria and the effects should be recorded. For example, because B. subtilis is gram-positive, Escherichia coli should be investigated because it is gram-negative5 which would show the differences between gram-positive and gram-negative bacteria which could be compared. The zones of inhibition are not even, which results in error when measuring them. To improve this investigation, the area of the zone of inhibition should be measured, instead of using a ruler to measure the diameter. The area could be measured by photographing the zones of inhibition, and using computer software to accurately measure the area, thus reducing the error in this experiment.
More research is needed to be done on the effects of silver ions on bacteria. This includes the effects on both gram-positive and gram-negative bacteria, as well as the optimum dose. It would also be beneficial to investigate whether the silver ions can be targeted at specific bacteria, which would help avoid killing friendly bacteria.
For a clearer pattern of the data, more values of concentration should be measured. This would result in a clearer trend line so patterns are more easily shown. At present, the zone of inhibition only averages an increase of 0.2cm over 0.1-1mol dm-3. To improve this, more values should be tested; such as 0.15 moldm-3.

Comment – This contains several common weaknesses.
It is evident that the student has simply followed a 'recipe'. Measuring the area of inhibition is the key dependant variable. Even the most simple trial would reveal this problem and provide an excellent opportunity for further individual development. Similarly the only other suggestion is one of poor practical skill or lack of care. Comments which are simply 'take more readings' are given little credit at this level. This would go very little beyond the 0-3 range
The June 2010 Examiner's report gives some clear guidance as to what might be expected for a high mark at A2 level. In particular some reference to possible systematic or random error, a brief analysis of repeat data to judge reliability or the problems of assigning causation to correlations. Addressing some of these points would raise this to a much higher level.

Communicating

C(a) The format of reports and the use of sub-headings was often good.
C(b) Similarly there was more attention paid to selecting relevant graphs in the correct format with accurate labelling and units. Where simple bar charts of means are presented it is desirable that full scale axes are used. The used of truncated scales often exaggerated differences and did not present an objective representation of the data.
C(c) In contrast there were many very poorly constructed bibliographies which did not give accurate references in any accepted scientific form. (See new exemplar material Dec 2010 on the Edexcel web site) Some examples are given below. There was still a strong tendency to copy the information from an internet address bar which often gave little or no indication of the nature of the material used.

Examples of references which are unclear

http://www.practicalbiology.org

http://www.exrx.net/Nutrition/Antioxidents/VitaminC.html

Prima Everest Sdn Bhd, available at:
http://www.primaeverest.com/index.php?dis=ethanol

Comment

The poorest reference here is merely a generic web site and would not indicate what has been researched or the information it contains. The others are specific but give little indication of what they contain without the reader using the internet to discover this for themselves.

The recommended format for such references is;

Authorship or Source, Year. *Title of web document* or web page. [type of medium] (date of update if available) Available at: include web site address/URL (Uniform Resource Locator) [Accessed date].

Many candidates used free online journal references to good effect but others did not include the name of the actual publication in their reference.

C(d) The examiners accepted good evaluation of a few selected sources as evidence for high marks especially where the bibliography was quite extensive. There was evidence that many candidates attempted to follow the advice given in the exemplar material and the June 2010 Examiner's report but they often did so by quoting a standard phrase without any evidence. This was particularly true of cross-referencing information where statements such as ' I found the same information on two other websites, showing that this is likely to be reliable' were often made without any evidence of what information or what other sources. Even where other sources were quoted they were sometimes simply different search engines linking the same original source. Overall many evaluations showed little understanding of 'credibility within the wider scientific community'

An example of poor understanding of scientific validity

http://www.dickcontino.com/clove.htm	*Organic Herbs Medicine Cabinet*	*Clove information.*	*Very Reliable*

Comment – this is obviously very weak but the site itself does give useful information which could easily be used in further evaluation. It has no named author and the following at the bottom of the page.

'Disclaimer: The information presented herein by Organic Herbs Medicine Cabinet is intended for educational purposes only. These statements have not been evaluated by the FDA and are not intended to diagnose, cure, treat or prevent disease. Individual results may vary, and before using any supplements, it is always advisable to consult with your own health care provider. '

The page also gives many clues as to its less than reliable nature 'Try Cloves as a **breath freshener** and, perhaps, even an **aphrodisiac.'**

Hence even a scientifically dubious source can provide a good deal of evidence for an effective evaluation.

A better evaluation
The final source used was needed to understand the potential mechanism

http://www.ncbi.nlm.nih.gov/pubmed/11908400

Date Accessed: 4th Dec 2010

used by sodium fluoride in toothpaste to inhibit bacterial growth. The specific article used was published by the faculty of dentistry at the University of Oslo in Norway meaning the author offers a level of expertise that is relevant and improves the credibility of the source. In addition, the website itself acts as an archive for biomedical literature from scientific journals and online books. This suggests that the article must have been peer reviewed prior to publication which heightens the credibility further. The purpose of the article is to inform and educate people on a particular scientific process and the theoretical basis of the piece suggests that there is little room for subjectivity, which makes the content more reliable. The only slight disadvantage is that the article was published in 1999 meaning it is 11 years old and therefore, despite providing scientific theory, current research has not been accounted for in the explanation of sodium fluoride's mechanism. This would compromise the credibility of the source as it is not contemporary and hence, some of the information provided may have been disproved since 1999. Generally speaking, however, this source was predominantly credible and fit for purpose.
***Comment** – a good attempt but the referencing is limited. This is actually an abstract found on Pub Med but does contain useful information. However there are details of the author and actual journal on the same page along with information that this has been cited in other papers so an opportunity has been missed to make this an accurate reference and an excellent evaluation.*

SUMMARY

Improving the weakest areas

- R(a) Ensure research is directly relevant to the hypothesis.
- R(a) There needs to be a brief explanation of why the investigation might be interesting biologically.
- R(b) Make sure it is clear how researched information has been used in explaining data.
- P(c) Trials need to concentrate on ensuring that suitable data is to be collected as accurately and reliably as possible not simply initial data collection with some unrelated modifications.
- O(b) Explain accurately why (or why not) there are anomalies and what action is to be taken.
- I(c) Consider methods and data in detail making evaluation analytical not a catalogue of practical mistakes or remedies for very poor planning.

- C(c) Improve accuracy of listing sources using suggestions from the exemplar material Dec 2010.
- C(d) Evaluate a smaller number of sources in greater depth and quote evidence.

A range of investigations submitted in June 2011

Music & memory
The effect of light intensity on rate of stomatal opening
Comparing antibacterial effects of penicillin and ethanol
wavelength & photosynthesis
pH and growth of brassicas
Manuka honey as an antibacterial agent.
Effect of glucose intake on short term memory
Colour and reading speed
Temperature and tendon flexibility
natural oils as antibacteial agents
response of blowfly larvae to light
Effect of menthol throat lozenges
Numbers of earthworms and growth
% Phragmites and distance from a lake
Distribution of earthworms
Age and memory
Caffeine and memory
Caffeine and reaction time
Woodlice as bioindicators of habitat quality
Distribution of barnacle species at different shore positions
Lugworm size and immersion time
Size of shore crabs in lower and middle shore
Effect of trampling on ribwort plantain
Distributon of plantain on a football field
Correlation of grass species distribution and age of dunes
Changes in length of Ascophyllum with height on shore
Distribution of colour morphs of flat periwinkles
Height: length ratio of limpets on dfferent shores
Lengths of first internodes of Ammophila on yellow dunes
Factors affecting opening times of stomata in Tradescantia
Effect of genetic differences in round and wrinkled pea seeds on initial water uptake
Effect of exposure on air bladders in F. Vesiculosis
Inhibition of catechol oxidase from banana extracts
Effect of Ca2+ ions on pollen tube growth
Effect of leaf litter depth on population size of woodlice
Does cellulase enhance the effects of pectinase?
Comparing size of purple topshells in rock polls and on bare rock
Effects of ascorbic acid on fruit browning

Abundance of water boatmen (Notonecta) in open water and reed beds
Biodiversity in oak and sweet chestnut leaf litter
How algal species affect mollusc distribution in streams
Correlation of mafly nymph distribution and water velocity
Inhibition of germination by plant extracts
Investigating the effect of different wavelengths of light on blowfly larvae
Investigating the effect of antioxidants in preventing UV damage
Investigating the effect of the epiphyte Polysiphonia on Ascophyllum nodosum fronds
Does immobilisation affect the rate of enzyme denaturation
Effect of trampling on the distribution of red fescue
Investigating the inhibitory effects of pine needle extracts
Does species diversity change with age of sand dunes?
The effect of wind exposure on star moss distribution
Lichen distribution on N and S facing walls
Distribution of non-biting midge larvae at different depths
Colour feeding preferences of garden birds
Inhibition of pectinase by tannins
The effect of Fe2+ ion concentration on tetracycline activity
Do ants communicate information about a strong sugar source
The effect of caffeine on short-term memory
The effect of light intensity on chirping rate in crickets
The effect of electrical stimulation on enzyme activity
The effect of ethylene on ripening
The effect of fungicide on mitotic activity
The effect of coppicing on species diversity
The fate of holly leaf miners in urban and rural locations
The effect of grazing on birds foot trefoil
Does the density of sycamore trees affect diameter of trunks?
The effect of pine trees on surrounding species diversity
The effect of mowing on the abundance of Achillea
Predator prey correlations between flatworms and freshwater shrimps
Effect of urea concentration on growth of legumes and non-legumes
colour perception in goldfish
Effect of light on movement in the roman snail
Sweat production measured by skin resistance in stress situations
Colour perception in human peripheral vision
Effect of exercise on human reaction times
The effect of age on human hearing range
The effect of nitrogenous fertilisers on legumes
Is pH denaturation reversible in immobilised enzymes?
Diurnal variations in human saliva production
Change in lichen abundance varies with distance from a city centre
Amylase activity in seeds at different germination stages.
Is hormone rooting powder necessary to produce successful geranium cuttings?

Differences in antioxidant levels in caffeinated and decaffeinated tea
Distribution of Pleurococcus on N and S facing tree trunks.
Effect of Ca2+ ions on rate of stomatal opening
Stomatal density in sun and shade leaves
Chlorophyll levels in sun and shade leaves
Effect of cooking time on Vit C

Appendix A: Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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