

Short Communication

## An Alternative Approach to Assessing Laboratory and Field Notebooks: The Data Retrieval Test

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### Abstract

*Marking field and laboratory notebooks can be a time consuming and tedious task. This article describes a system whereby the contents of student's notebooks are assessed by testing the students on what they have included and their understanding of what has been done. It also tests the quality of the student's notes – detailed, organised notes result in higher marks than sketchy disorganised ones.*

*The 'Data Retrieval Test' is an open book test in which the notebook is taken into the exam room and questions are asked on its contents. The questions are based on what the tutor knows should have been included. A survey of third year degree students showed that this type of test is seen as a fair method of assessment. It is also popular with staff as it can reduce the marking time by up to 80%. The marks obtained by this test are in line with those obtained by more traditional methods of assessment. It can be adapted to assess students at different stages of their academic career.*

**Keywords:** Open-book test, notebooks, practical assessment

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### Introduction

Perhaps the most famous set of biological notes are those made by Charles Darwin. The meticulous records made during his voyage aboard HMS Beagle were directly utilised years later in writing *On the Origin of Species by Natural Selection*. Throughout his life such note-taking continued to be a feature of Darwin's scientific method. Indeed their importance as a primary source has led to them being made available online ([www.darwin-online.org.uk](http://www.darwin-online.org.uk)).

While it is unlikely that the notes of today's Biology undergraduates will be as scientifically significant as Darwin's, keeping a field or laboratory notebook is still an essential skill for all aspiring scientists. The notes should contain sufficient detail to enable the writer to understand at a later date what was done, its rationale, the results and subsequent analysis and interpretation. Excerpts showing good examples of notes are shown in figs 1 & 2.

### Notebook skills

It takes practice to produce a useful notebook and students need to be taught how to develop this skill, particularly with the markedly reduced emphasis on laboratory and field notes during pre-university education. There is abundant advice on writing field and laboratory notes on the internet, good advice is also given in Jones et al (2007). Laboratory notes are typically a record of procedures (e.g. dilutions) alongside resultant calculations or graphs. By comparison field notebooks are likely to include names and characteristics of species and habitats encountered, with any numbered samples noted for cross referencing. Likewise subsequent figures and calculations would be included. Regardless of the location of the practical a notebook should contain details of methods and equipment and any adjustments that were made as a result of trials. Often students are given a method sheet which can be pasted or stapled into the book rather than rewriting it. It is important that the information is inserted in such a way that it is not lost. The results of calculations should also be included.

Ideally the notes should be taken at the time and not transcribed later, however some students like to make their work neat and it is hard to persuade them that, so long as it is legible, especially to them, a less than pristine notebook is quite acceptable. It is anticipated that students will return to the notes to develop analysis and interpretation. Figs 1 & 2, show a highly organised set of notes written up later from field notes with additional analysis. If this is done then the writing up must be done while the practical work is still fresh in the students mind or vital aspects will be omitted.

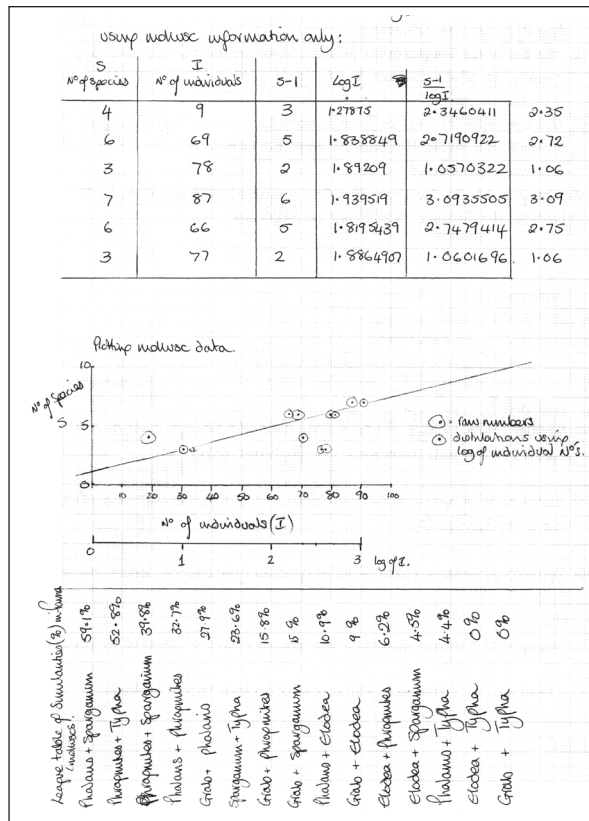


Figure 1 A page from a field notebook showing the level of calculations expected

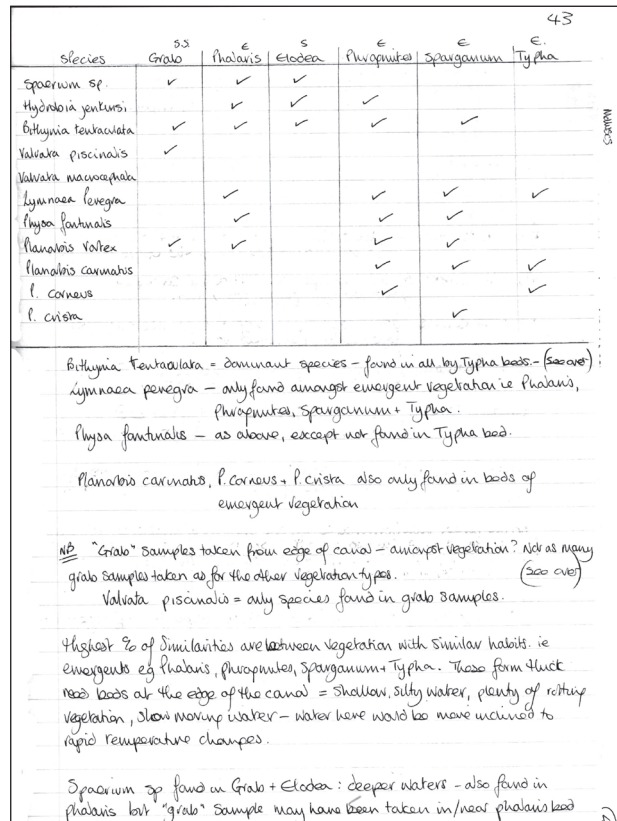


Figure 2 This page illustrates the detail needed in a good field notebook

### Assessment – The Data Retrieval Test (DRT)

If keeping a notebook is an integral part of a scientist's education then it follows that there should be a way of assessing it. Simply taking in the book and marking it according to a set of criteria is the traditional approach. However this has several drawbacks including the marker struggling to read a student's layout and writing, the great time commitment required by marking and the subsequent failure of students to read feedback, resulting in repeated mistakes (Hughes, 2004). Moreover the collection of notebooks often engenders a last minute panic with students copying each others work and the marks attained can be unrealistically high for some students. Hughes (2004) has considered various ways of reducing the pressures of marking notebooks including group reports, reduced write-up requirements, multiple choice questions and peer and self assessment. While these approaches all have their value here we present an alternative approach based upon an open book examination of a notebook, termed a Data Retrieval Test (DRT). This has been successfully utilised at Edge Hill University for over a decade with undergraduates at all levels and also with visiting sixth form groups.

Essentially, students are allowed to take their field or laboratory notebook into a time-limited examination which features questions directly relating to the work in the notebook. Fig 3 shows details of questions used to test the notes shown in Figs. 1 and 2. If the notebook has been well maintained, organised and subsequently used to develop analysis and interpretation then

the information should be relatively easy to retrieve and the DRT marks will be high. In a disorganised notebook, rarely opened since the end of the teaching session, information will take longer to find, be less complete and fewer questions will be answered in the allotted time.

5. Which of the faunal samples from the canal,

- gave the highest value of Margalef's Index of Species Richness?
- contained most species?
- Why are the answers to i. and ii. not the same?

6. Using the mollusc data only,

- which pair of samples shared the same dominant mollusc species?  
 and
- Identify the **major** way in which those two samples differed.
- Using percentage similarity coefficients,
  - what was the highest value obtained,   
 and for what pair of samples?
  - which pair(s) of samples gave coefficients of 0 (zero)?  
  
 and what have **the rest of** the samples in common?
  - which sample gave the *highest mean* coefficient of similarity,   
 and which sample gave the *lowest mean* coefficient?

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**Figure 3** An example of part of the Data Retrieval Test relating to the information in Fig. 1.

### Student attitudes to Data Retrieval Tests

A class of 60 students just beginning their final year of a Biology degree were asked for their opinions of data retrieval tests. These students had been previously exposed to DRTs in both first and second year modules. Some of their responses are given below.

*"I find it relaxing to know that, in theory, the answers are in front of you if you have made the correct notes"*

*"With perfect notes the test is a walk in the park"*

*"It teaches us to keep our notebooks organised"*

Around 95% of the students questioned (n=57) felt that the tests were useful and that their ability to perform well in them had improved over the years of their study. Perhaps unsurprisingly, the less positive responses tended to come from the less organised members of the group. The overall response from this class was very positive and echoes previous comments from end-of-module feedback.

## **Discussion**

Over a decade's experience and refinement of DRTs at Edge Hill University has shown them to be an excellent way of developing and assessing note-taking, analysis and interpretation of results. It has the notable advantage over marking notebooks that students are assessed on their ability to use their own notes, rather than the assessor's estimation of how useful those notes might be. However students need time and encouragement to develop these skills and early in the course it is a good practice to give short regular assessments in order to ensure that the notes being kept are appropriate and DRT skills are being developed.

DRTs are popular with students, this is perhaps largely due to the open book nature of the assessment which is widely acknowledged as reducing student stress (eg. Francis, 1982; Boniface, 1985; Feller, 1994; Theophilides and Dionysiou, 1996). It is also popular with staff given that it significantly helps to fulfil the aims of practical work, it encourages attendance at all sessions as any practical work can feature on a DRT and it also requires noticeably less marking time than assessing notebooks directly, perhaps as much as an 80% reduction.

The method of assessment can also be tailored to increasingly demanding Learning Outcomes. Within the first year of a degree the questions set are used to encourage good records. Once this is established, questions requiring greater analytical skill and interpretive ability can be incorporated into the assessment. Hence towards the end of a degree students will be expected to have undertaken demanding analysis themselves and put their work in a wider context. Essentially students are required to engage fully with the practical work undertaken and the requirement of accuracy, completeness and interpretive ability demands greater understanding of the material than simple rote learning. For instance an exercise using freshwater invertebrates to determine water quality will generate questions that require dates, map reference of site, number of replicates for first year students. However a similar exercise for final year students would expect them to calculate pollution indices from the data and to interpret the results in the light of published work. Additional questions could be developed through presentation of similar data on the DRT with students being required to interpret the new information. Such searching questions, requiring a good understanding of the fundamental concepts, mean that DRTs can be used to measure the effectiveness of the student's note-keeping and also their fuller understanding of the work.

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