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Close window
by Alistair Morgan, adapted by Chris Pegler

'None of the experiments or demonstrations ever work out the way they are expected to. And we never get a chance to discuss them, so we pretend it all works, write it all up and move on to the next lab.'

As a demonstrator, I asked a student informally: 'How are you getting on? Which experiment is it that you are doing?' The student's response was: 'Wait a moment, I've forgotten - I'll just look in the lab manual to see what it is.'

'I'd imagined that this was going to be a very practical field course, but some of the days were more like coach trips with a tourist guide telling us what to see.'

'The demonstrator was a brilliant teacher; she really helped me to understand the fieldwork and the course as a whole - she seemed to be in touch with problems of learning in the subject through the questions she asked me.'

How is it that there is such a variation in how students experience laboratory classes and field trips? As a demonstrator, what can you do to ensure that students do not carry out experiments in an unreflective and unthinking manner, as in the first three quotations above?

Being a demonstrator in higher education is a teaching role for which little training or guidance may be provided. Yet, for students, the teaching skill of the demonstrator can have a significant influence on their experiences of learning. Demonstrating is an area of teaching where, individually or in small groups, students receive tuition related to their own study concerns or difficulties. Although the term 'demonstrator' probably originates in laboratory-based science subjects, the title is also used for junior teaching staff in subjects with fieldwork, such as geography, environmental science, architecture, computer laboratories and some areas of the social sciences.

In some ways, the style of teaching required of demonstrators is not dissimilar to small-group teaching; the work involves explaining things, supporting students, showing them how to do things, helping them with conceptual development etc. And given the non-threatening context of 'demonstrating' - either the laboratory or perhaps a field trip, with a relatively informal setting - there is a unique opportunity for the demonstrator to find out about students' difficulties, often on a one-to-one basis. As a demonstrator, you are in a unique position 'to start from where the student is at' in conducting your teaching.

But what actually is your role as a demonstrator and what skills do you need? What are the aims of the laboratory class or field trip you are teaching? Are these aims communicated to the students clearly? And to what extent do students' perceptions of the aims of laboratory teaching match the intentions of the faculty staff who designed the laboratory programme? How can you help students to overcome the problems they present to you, so that their outcomes of learning in the laboratory or in the field are 'positive' and beneficial and contribute to their understandings of the subject?

This part of H850 explores what can happen in both laboratory and fieldwork teaching and the sorts of problems that can arise for students. As a demonstrator, you are in a unique position to ensure that your students do not end up with bad experiences like some of those quoted above.

Sources and resources

In this collection of 'learning objects' we draw on work by Brown and Atkins (1988) to explore the overall aims and purposes of laboratory teaching and some of the research studies that have attempted to establish these aims. This work illustrates the diversity of the possible learning outcomes of laboratory work, and how this provides the potential for confusion and ambiguity for students.

Reference to work by Kent, Gilbertson and Hunt (1997) (Fieldwork in geography teaching, What types of fieldwork are there? and Objectives of fieldwork) underpins our discussion of the aims of teaching through fieldwork in geography. The article from which these are taken concentrates on how the discipline area (in terms of its content and research methodology) is perceived by academic staff, and how changes in the discipline have influenced the use of fieldwork. Although based on geography fieldwork, it raises many general issues that are relevant to a number of other discipline areas which use fieldwork.

Overview

Through this collection of learning objects, we explore the variety of aims and purposes of laboratory work and teaching through fieldwork and how these influence your work as a demonstrator. These are not just the concerns of the senior staff who design the courses. To the contrary, they are essential for you as a demonstrator in informing what you actually do. Only with an understanding of the intended aims will you have a firm basis for responding to the wide range of questions from students you will have to answer. Also the particular aims of a laboratory or field session will influence the main skills which you will need as a demonstrator.

We look at appropriate responses to students' requests for assistance or responses to their mistakes or problems informed by the aims of the
laboratory class or field trip. How you respond to your students will draw upon skills discussed elsewhere in this course. These skills could be regarded as the sub-skills of demonstrating in that they need to be performed within the overall context of the aims and purposes of the laboratory or field trip. Your own reflection on your experience and confidence of the range of skills will be an important part of your professional development as a teacher in higher education.

We will also introduce alternative strategies for getting involved with students during practical sessions, but we cannot tell you what to focus on once you are talking with students or in what direction to steer discussion with students. For this, you need to be aware of the aims of the session and of the course of which it is a part.

We hope you will not read these materials in a linear way, from beginning to end, but rather dip into them as and when you experience things in your teaching you would like to explore further. Some of the materials are designed to be returned to several times as you discover more about what is going on in your demonstrating and as you gain the confidence to experiment. There are many practical suggestions here and you are not expected to try them all! Also, demonstrating takes place in a wide variety of settings - a wider variety than is represented in the methods and examples in these appendices. You will have to use your creativity to adapt ideas to your context.

References


This part of the course is available online as a series of digital 'learning objects'. In arranging the content in this way, so that each short section can be accessed separately and (largely) independently, we hope to encourage flexible use of the material. Many students of H850 will not be involved in demonstrating and may find all that they need by browsing the sections of the website that interest them, picking and choosing amongst the topics here. Other students will find that demonstrating and fieldwork are important aspects of their teaching practice and may wish to revisit particular topics repeatedly, printing out and using some of the checklists, or downloading and adapting these to suit their personal preferences.

As emphasised in the overview for this part of the course the website is intended to be a flexible resource to suit your requirements. You are not required to read all the pages, or to follow a set sequence in your reading. How much or how little you use or refer to this material is a matter of personal preference or interest. This flexible approach to use is also supported in the other online sections of Pack 5.
H850 What are the aims of laboratory work?

by Alistair Morgan

Since laboratory experiments and experimentation are central to a scientific subject, it might appear that laboratory practical work should be a central and unproblematic area of the curriculum. However, the aims of laboratory work are diverse; for example, they cover developing skills with particular apparatus, teaching theoretical concepts through the laboratory experiments, understanding the problem-solving and philosophical aspects of science, and the role and place of practical work in the study of science. Consequently laboratory work is a contested and controversial area of the curriculum.

Some of the research literature has attempted to establish the relative importance of various aims and objectives through surveys of university teachers and professional scientists in the disciplines. For example, Hegarty-Hazel (1990) suggested that the choice of goals for laboratory teaching should be from the following list:

1. teaching manipulative skills and increasing understanding of the apparatus;
2. fostering understanding and experience of scientific inquiry; practice in designing and executing experiments, generating data for analysis and interpretation;
3. developing attitudes to science laboratory work, resourcefulness, creativity;
4. introducing a new discipline, providing for individual differences, providing concrete learning experiences;
5. fostering a sense of success, motivation and control in science.

(Hegarty-Hazel, 1990, p. 15)

'Effective Laboratory Teaching' by Brown and Atkins (1988), reproduced as Extract 1, expands these aims and looks at more general issues about teaching and providing explanations. This extract also makes reference to 'learning by doing', as a distinctive characteristic of laboratory teaching. However, the learning tasks (the experiments) have to be perceived as relevant by the students. Of course, this begs the question, 'relevant to what?' Assuming you, as demonstrator, are teaching a laboratory class where students are working from well-prepared manuals, your role is likely to be supporting students through the individual difficulties they encounter, but at the same time maintaining the focus of their attention on the 'learning by doing' and the key aims of the experiment. It is not uncommon for students to get 'bogged down' in the manipulative aspects of an experiment, through lack of familiarity with the apparatus, when the key aims of the experiment are concerned with wider issues about problem-solving and the empirical nature of science. Also for students, when the overall aims and purposes of a particular laboratory experiment are not clear to them, they are likely to adopt an unreflective approach to their work, using the laboratory manual as a 'recipe book' consisting of a set of procedures to be followed in a mechanistic fashion. In your work as a demonstrator, you will be taking an active role in helping your students to understand the aims underlying the laboratory activities.

References

(Reproduced as Extract 1)

The Student Laboratory and the Science Curriculum, London, Routledge.
Practical work has a time-honoured place in the education of scientists and engineers. Most practical work occurs in laboratories but fieldwork, placements, and sandwich courses are also important features of some courses. In this chapter, we will be looking primarily at the uses, skills, and methods of laboratory work, although many of the activities, hints, and suggestions that we offer also apply to the organization of fieldwork, placements, and sandwich courses.

The practical work is the most expensive part of an engineer’s or scientist’s education. So, at a time when departmental grants are being cut and demonstrator time is being reduced, it is particularly appropriate to consider ways of making practical work more efficient and more effective in your own courses.

The major goals of practical work are:

1. Teaching manual and observational skills relevant to the subject.
2. Improving understanding of methods of scientific enquiry.
3. Developing problem-solving skills.
4. Nurturing professional attitudes.

The first three of these goals are self-explanatory. The fourth is more subtle and is probably the most important long-term goal. It is also the most elusive. Most of us hope that our students will develop a commitment to the subject that we teach and that they will incorporate its values into their thinking and actions. Practical work can, and should, provide the opportunity for such attitudes to grow.

Laboratory teaching in perspective

In Britain the use of laboratories in undergraduate teaching dates back only to the mid- and late nineteenth century (Brock and Meadows, 1977; Phillips, 1981). Neither Oxford nor Cambridge had undergraduate science laboratories before 1870. There was considerable resistance to the notion of practicals in the nineteenth century - just as today there is some resistance to the notion of changing the underlying approach to practicals.

Most of the early practicals were essentially demonstrations of important principles. They were also used to train students to build equipment and make accurate measurements. Later, practicals became exercises that led students to the ‘right’ answers. These traditions of laboratory teaching still persist - and, some would say, rightly so. During the past twenty years, however, there has been increased interest in the use of laboratories as a training ground for independent scientific enquiry. This interest has led to a spate of new methods and to reappraisals of the uses and methods of laboratory teaching. The recent studies of laboratory teaching may conveniently be divided into three groups: surveys of practices, studies comparing laboratory work with other methods of teaching, and reports of new approaches to laboratory teaching. [This extract looks at just the first.]

Surveys

Most science and engineering students in Britain spend between 50 and 70 per cent of their contact time in laboratory work. Chemists spend over 500 hours per year, biologists about 400 hours, and physicists about 300 hours per year in laboratories (Aspden and Eardley, 1974). These differences may, in part, be accounted for by differences in manipulative skills required by different subjects. Chemical separation and distillation, dissection, and microscopy involve highly complex motor skills that may require intensive practice.

Time spent in practicals seems to be matched by private time spent on practicals. Fifteen years ago science and engineering students reported that they spent most of their private study on writing up practicals and that each major practical took up to seven hours to write up (Entwistle, Percy and Nisbet, 1971). These findings may still hold today, although many departments no longer insist that all practicals are written up fully. Even so many departments do not mark practicals and in others laboratory work may count for as little as 5 per cent of the degree assessment. The importance of practical work is not always reflected in course marks (Thompson, 1979) ... One reason for this may be that marking of laboratory notebooks is often unreliable. Wilson et al. (1969) in their study of laboratory assessment discovered a 25 per cent variation in marks between sets of demonstrators who marked the same laboratory notebooks. Such variations can, of course, be reduced considerably by the use of double marking, explicit criteria, and by training demonstrators to mark consistently. Perhaps the most important survey of teaching work in recent years is the Higher Education Learning Project (HELP) in physics. Bliss and Ogborn (1977) report the results of their survey and of discussions with lecturers, demonstrators, technicians, and students on the place of practical work in several university courses. Many students disliked practical work until they were doing their project or long experiment in the final year. Demonstrators sometimes were uncertain of their role and students reported wide variation in the quality of help from demonstrators. Daines (1986) in a subsequent study explored students’ expectations of demonstrators. Most students valued the characteristics of fair marking, constructive criticism, clear explanation of errors, written comments on the students’ work, and listening to students’ questions.

Skills of laboratory teaching

Laboratory teaching often involves giving brief explanations and instructions to the whole class and then dividing the class into pairs or small groups who work on a particular experiment. So, not surprisingly, some of the skills of laboratory teaching are similar to those of lecturing and small group teaching. We need to create interest, and to explain technical information; we need to ask students the right question, to know when to exercise control and when to let go, and how to judge the level of demand. Most important of all, we need to put ourselves in the
place of the students who are doing the laboratory course so that we can choose appropriate experiments, give the right instructions, and make laboratory work into a challenging and rewarding experience.

Laboratory teaching also involves skills concerned with giving directions, with helping demonstrators and technicians, and with designing, organizing, and implementing laboratory work. [Below is] a list of essential skills of laboratory teaching ...

The skills of laboratory teaching

- Explaining and presenting information.
- Questioning, listening, and responding.
- Giving directions.
- Teaching demonstrators.
- Helping technicians.
- Preparing a laboratory course.

Uses of laboratory work

Most of the uses of laboratory work may be subsumed under the following goals:

- Teaching manual and observational skills relevant to the subject.
- Improving understanding of methods of scientific enquiry.
- Developing problem-solving skills.
- Nurturing professional attitudes.

The main principle underlying laboratory work is that students learn effectively through doing practical tasks. Certainly even the most sophisticated learners benefit from concrete experiences particularly in new topics. But the principle of ‘learning through doing’ needs two qualifications. First, the tasks have to be perceived as relevant and meaningful by the students - otherwise interest may be minimal. Second, students (and lecturers too) have to receive constructive feedback on their performance - otherwise learning may be minimal. Practice does not itself make perfect but practice with feedback almost always improves performance. These points should be borne in mind when designing laboratory courses and marking laboratory work ...

Teaching demonstrators

Broadly speaking the role of the demonstrator is to help students to carry out their activities. The student activities may consist of following instruction, solving a design problem, setting up apparatus, checking the apparatus works, obtaining, observing, and recording results, calculating results, noting any peculiarities in methods or results and, perhaps, linking the results to theoretical principles or other results. So clearly the demonstrator must understand the experiments, be familiar with the equipment and procedures, and know how to write good laboratory reports. This is necessary but not sufficient knowledge. Knowing how to do the experiment is one thing. Knowing when and how to help someone else carry out the experiment is quite another ...

[Below is a list of] skills required by demonstrators that our colleagues at Nottingham, Loughborough, and Newcastle found useful.

Demonstrator skills

Know how to do, and write up, the experiment AND:

- Observe students at work.
- Anticipate major difficulties of understanding.
- Recognize major difficulties of understanding.
- Give brief, clear explanations of processes and procedures.
- Give directions.
- Ask questions which clarify difficulties of understanding.
• Ask questions which guide students.

• Answer questions in a simple, direct, and non-critical way.

• Offer supportive and encouraging remarks.

• Know when to help and not help a student.

Reference

A student comes to you because he cannot get his oscilloscope to work - it could be central or incidental to the lab session. What should you do?

What should interventions be based on? You need to consider the aims and purposes of laboratory teaching so that you have a firm basis for deciding how to respond to the teaching challenges such as those set out in the above scenario.

An obvious response to this student's plight might be to set up equipment for him so that he can get on with his work. But suppose the main purpose of the lab was to learn how to set up the equipment. In this case your response might be influenced by models of skill learning and your goal might be to teach him to set equipment up for himself. Your intervention might go something like this:

1. Get the student to show you what he can already do so that you know at what level to start.
2. Demonstrate how you would set up the equipment, breaking up the task into stages if necessary and explaining as you go along.
3. Ask the student to demonstrate to you how to set it up, explaining back to you why he is doing it like that.
4. Check whether he can set it up on his own for a slightly different experiment.

Extract 1 'Effective laboratory teaching' discusses these skills in greater detail.

If, in contrast, the purpose of the lab session is to interpret data collected using the oscilloscope so as to understand a scientific concept, then the above intervention would be quite inappropriate. Instead, you might have been influenced by models of concept learning and your intervention might have gone something like this:

1. Suggest in a supportive way that the problem with the oscilloscope does not matter in this session and that the student should borrow another's data to work from, or help him to collect the necessary data as quickly as possible.
2. Ask the student to explain the scientific concept, to find out his current level of understanding.
3. Offer your elaboration of the concept, building on what he already understands.
4. Ask him to try and make sense of the data using this concept, prompting him with questions and suggestions.

Activity: 'Fit for purpose interventions'

Following the above two examples, what might have been an appropriate intervention if the aim of the session had been:

1. developing experimental design and problem-solving skills;
2. fostering professional attitudes and safe working practices?

These interventions, as well as being directed at achieving very different goals, use a range of different skills. Try going through all of the above interventions and listing for yourself the skills you think are involved.

The different examples of interventions based on the same 'presenting problem' show how both the purpose of laboratory sessions and detailed teaching skills are involved.

References

(Reproduced as Extract 1)
H850: What skills do demonstrators in laboratories need?

by Alistair Morgan

**Activity: Your skills as a demonstrator**

Read [Effective Laboratory Teaching (Extract 1)](http://students.open.ac.uk/desktop/h850-05k/files/demonstrating.zip/demo_skills.htm23/04/2007 12:36:51) and then, for each of the skills below (adapted from the list in the extract), note how experienced you are.

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<th>Skill</th>
<th>Very experienced</th>
<th>Quite experienced</th>
<th>Not at all experienced</th>
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<td>Observing students work</td>
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<td>Anticipating major difficulties of understanding</td>
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<td>Recognizing major difficulties of understanding</td>
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<tr>
<td>Giving clear explanations of processes and procedures</td>
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<td>Giving directions for using equipment</td>
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<tr>
<td>Asking questions which clarify difficulties</td>
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<tr>
<td>Answering questions in a simple and non-critical way</td>
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<td>Offering supportive and encouraging comments</td>
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<tr>
<td>Knowing when to help and when not to help a student</td>
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1. How can you improve your experience of those areas where you are currently inexperienced? Consider who you might ask for advice? What sort of support is available. What aids you might use or adapt.
2. For each skill how will you know whether and how much you have improved?

**References**

(Reproduced as Extract 1)
The use of computers and communications technology has become an integral part of all disciplines that use laboratory, practical and fieldwork to the point where the nature of that work has changed. The teaching of information skills has been transformed by the impact of IT. But IT also offers demonstrators new tools to improve learning. A list of possibilities is provided here.

Pooling and analysing data

Customised spreadsheets can make it easy for students to enter and combine their experimental findings in the lab (or on a laptop or PDA in the field) to allow whole-class analysis immediately for discussion at the end of the session. Mobile computing (wireless communications) may also allow sharing and analysis of findings during field trips. Some equipment also allows automated data capture.

Analysis and display

Statistical analysis and graphical display can help to explain the meaning of results visually, as can graph plotting. It can be easy to manipulate such graphs visually to explore the implications of different findings and demonstrate the significance of concepts such as 'error', 'significant difference' and 'variance'.

Simulation

Computers can simulate the performance of engineering structures, the behaviour of the human respiratory system or what happens to successive populations of plants in a hostile environment. This can allow impossibly large-scale, time-consuming, expensive or dangerous 'experiments' to be undertaken in seconds. Students may then be able to carry out many more experiments, to test out experimental designs and explore their understanding of phenomena and underlying mathematical models in ways which were previously impossible. Developments of 'virtual field trips' in geography and archaeology have stretched the boundaries of the scale of learning activity that can be undertaken at a desk. Computer simulation can be used as an initial briefing to a conventional lab, as a direct substitute, or as a conceptual tool to explain the results of conventional practical work.

Access to remote sources

Remote data sources can be accessed and analysed, obviating the need to collect data, visual material can be accessed via the Internet, and the library and remote laboratories or instruments can be brought into the lab or out into the field electronically.

Assessment

Multiple-choice question testing of background knowledge can be used to encourage students to prepare adequately. Recent developments in testing software mean that visual recognition that used to be done in the field (such as identification and analysis of the sequences in which sediments were laid down) can now be tested at a computer with results stored, analysed and reported electronically.

Activity: Exploring examples of web-based demonstrating

Recent examples of a variety of web-based demonstrations can be found in the abstracts from the 2002 Workshop on Fieldwork Education and Technology on the Geography, Earth and Environmental Sciences LTSN (Learning and Teaching Subject Network) site.

1. Take 30 minutes to explore some of these abstracts and note or bookmark any sites which are particularly informative or interesting to you.
2. Consider how much further you would expect web-based demonstration work to progress during the next 2-3 years. Which developments interest you most?
Students often spend as much time writing up labs, practicals and fieldwork as they do undertaking that work in the first place. This writing up can be an invaluable learning activity without which the benefits of the session could not be achieved, or a boring waste of time for both the students and the unfortunate marker. You can support student learning from report writing in the following ways:

- Make your expectations clear. This can involve providing a model report of a similar session, a standard format of headings with short explanatory text about what should go in each section, or a set of criteria which will be used in marking.
- At the end of a session briefly discuss what needs to be written up.
- Pool markers’ feedback comments on the previous report and give a briefing at the start of the next session outlining the main things students have been doing well or badly.
- Ask students to assess their own reports before they submit them, using a standard feedback sheet or list of criteria.
- Suggest that students swap their reports with one other person and get constructive feedback before improving and submitting it for marking.
- Undertake a marking exercise in which one good and one borderline pass report are anonymised and marked by the whole class, and their views of the reports’ strengths and weaknesses discussed and compared with your judgements.

Activity: Review your student report writing

Look back through a pile of reports you have just marked. Try to spot features of student writing that might benefit from some attention during your next lab or practical session. Which of the following are evident?

- A lack of understanding of the purpose of the session being reported
- A lack of understanding of underlying theory and principles
- Missing material or whole sections
- Material located under the wrong section headings
- Ambiguous or confusing expression
- Inappropriate/unscientific forms of expression
- Incorrect data analysis
- Incorrect data interpretation
- Other problems ...

What might you do in your next session to address any of these problems?
In your work as a demonstrator on a field course, you need to know the background to the design of teaching, so that your responses to students' questions concentrate on the intended aims of the fieldwork. Being a 'good demonstrator' means that you are able to help students become aware of how and why they are doing various activities. You can put the 'learning by doing' in a wider context of the discipline area for your students. To encourage students to engage in reflection in learning on their fieldwork is of crucial importance, if you are to help them to achieve the intended objectives and avoid negative experiences.

What is fieldwork for?

Debates about the aims and purposes of fieldwork have many similarities with the issues discussed in the section on laboratory teaching. In some subject areas, the practical aspect of fieldwork is regarded as central to the nature of disciplinary knowledge and so fieldwork is automatically an essential part of the curriculum. However, it is this assumed and unquestioned inclusion in the curriculum that we want to tackle here.

In Extract 2, 'Fieldwork in geography teaching', Kent, Gilbertson and Hunt (1997) set out how they see the changing nature of fieldwork. Some of these changes are as a result of how academics and professionals understand their discipline area, and others are as a result of the 'external environment', which includes the Enterprise in Higher Education Initiative and pressures to teach increasing student numbers without increases in funding. These authors also present a typology for looking at the variations in fieldwork using two dimensions: first between 'observational fieldwork' and 'participatory fieldwork', and second between 'student dependency' and 'student autonomy' (Figure 1 in the extract). Although the issues are discussed in the context of geography, the ideas seem to be applicable to other subject areas that adopt some form of fieldwork in their teaching.

As a demonstrator, you need to know the assumptions about the design of the fieldwork. It will help you develop your teaching, for example, to know when to intervene to carry out procedures for your students, or when not to help them, so that they can learn through figuring out the answer to their problems themselves. Being able to stand back and allow students to solve problems themselves, often collaboratively in small groups, while maintaining a sense of their overall progress, is an important skill of being a demonstrator. To be able to develop this skill, you need a wider knowledge of the aims and purposes of teaching through fieldwork as the basis for your teaching.

Your experience of fieldwork

In contrast to the task and subject focus of Extract 1 'Effective laboratory teaching', Extract 4 'Objectives of fieldwork' highlights the importance of the development of transferable skills, and of social and personal development, during fieldwork.

Activity: Dimensions of your fieldwork

1. Think of a particular field trip you are familiar with:
   - What transferable skills were used by students?
   - What social and personal development of students was involved?
   - What role could a demonstrator have had in maximising such development during that field trip?

2. In Figure 5.2 of Extract 3 'What types of fieldwork are there?', the authors set two dimensions: first between 'observational fieldwork' and 'participatory fieldwork', and second between 'student dependence' and 'student autonomy. Try plotting onto this framework a recent field trip where you worked as a demonstrator.

3. How might this plot of your fieldwork influence what you do as a demonstrator?

Reference

Definition of 'the field' and the changing nature of fieldwork

Lonergan and Andresen (1988) define ‘the field’ as any place ‘where supervised learning can take place via first-hand experience, outside the constraints of the four-walls classroom setting’ (p. 64). The range of fieldwork delivery methods and styles varies considerably and the type and style of fieldwork within geography has changed rapidly since the 1950s.

In Figure 1 a general model summarising the major shifts of emphasis and approach in field teaching in geography over the period 1950-97 is presented. Obviously, patterns and the exact timing of the adoption and integration of the different approaches have varied from one institution to another. For example, some geography departments will claim always to have done project-based fieldwork since the 1950s. The early role and continuing significance of the Field Studies Council in this respect deserves mention (Barrett, 1987).

Gardiner (1996) has stressed the dynamic nature of approaches to fieldwork teaching and the need for both staff and students to adapt to change ...

Figure 1 Changing approaches to fieldwork in geography 1950-97. [The approaches are cumulative.]

<table>
<thead>
<tr>
<th>Date</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>Traditional 'look-see' or 'Cook's Tour' field course</td>
</tr>
<tr>
<td></td>
<td>- observational and descriptive</td>
</tr>
<tr>
<td>1960</td>
<td>'landscape'-based or centred on 'sight-seeing' visits to specific sites of interest</td>
</tr>
<tr>
<td></td>
<td>- passive student participation</td>
</tr>
<tr>
<td>1970</td>
<td>'New' Geography - 1960s 'revolution' Problem-orientated, project-based fieldwork</td>
</tr>
<tr>
<td></td>
<td>- inductive and deductive approaches (positivist) hypothesis generation and testing, data collection and statistical analysis, interpretation and report writing</td>
</tr>
<tr>
<td>1980</td>
<td>- detailed scales, often carried out in a small area</td>
</tr>
<tr>
<td></td>
<td>- active student participation although often staff-led</td>
</tr>
<tr>
<td>1985</td>
<td>Enterprise in Higher Education - Transferable skills Problem-orientated fieldwork still dominant but Thematic and introduction of transferable skills element guided trails</td>
</tr>
<tr>
<td></td>
<td>- project design skills - individual student initiative</td>
</tr>
<tr>
<td></td>
<td>- organisational skills - group initiatives</td>
</tr>
<tr>
<td></td>
<td>- leadership skills - feedback on completion</td>
</tr>
</tbody>
</table>
### 1990
**Massive growth in student numbers - teaching large classes**

- Group skills
- Active student participation but emphasis switches from staff-led to student-led projects
- Field courses incorporate elements of all previous modes of fieldwork
- May commence with 'look-see' perhaps combined with thematic guided walks/trails
- Followed by staff-directed, problem-orientated projects
- Then student-initiated problem-centred work with added dimension of transferable skills

### 1997
**Serious problems of cost of fieldwork to both Departments and students combined with even larger classes**

- The future?
- 'Virtual reality' to assist with field courses
- But will 'virtual reality' be any cheaper or ever be as satisfactory?

### Reference
As Figure 5.2 shows, in practice, there is a continuum of types of activity available in the field, characterised by different forms and levels of student and staff involvement. From the student viewpoint, all field activities can be placed somewhere on two continua: first, between observation and participation; second, between dependency and autonomy (Figure 2). Many field courses involve several different combinations of activities.

**Figure 5.2 The continua of autonomy and participation in fieldwork**

**Observational fieldwork**

Observational fieldwork is an important way of passing on staff experience and ideas, and is comparatively easy to organise. The principal problem with observational fieldwork is that students are only required to 'be there' with the result that their attention may actually be elsewhere, especially if the experience is protracted.

- The simplest and most traditional form of observational fieldwork is the 'Cook’s tour' or 'look-see' field visit. Students often describe this type of activity as boring, since they are not deeply engaged in the fieldwork process (Brown, 1969), but it can be useful at the start of a field course, to give a first overview of an unfamiliar landscape. Couch (1985) argues that carefully directed observation can be a useful learning method, especially if reinforced by on-site tutorial-style discussion.

- Students become more engaged, typically, if the tour is on foot and they have the opportunity to converse with staff, rather than being lectured at (Gold, 1991). This format allows students to make some observations independently and to follow up, in an informal way, issues they find interesting with staff.

- Unfortunately, during observational fieldwork, if unprompted, students often miss key features, and if prompted, have a tendency to reproduce the staff viewpoint uncritically (HMI, 1992; Haigh and Gold, 1993). Engagement can be encouraged by informing students before the start of the fieldwork that they will be required to submit an assessment describing phenomena that they themselves, rather than the staff, have seen.

- The art of field note taking on observational fieldwork always has and continues to cause problems for many students. Lewis and Mills (1995) provide a useful set of guidelines, particularly with respect to field sketches and the need to annotate them clearly.

- An increasingly popular option is a tour or site visit with worksheet (Pedersen, 1978; Keene, 1982, 1993; Habeshaw et al., 1992; Slater, 1993) or map (Brown, 1969), with questions to answer from student observation. Self-guided excursions, town and countryside trails are a more autonomous and sophisticated version of this type of exercise (Keene, 1987a, 1989). Many new trails have a sequence of activities to challenge and involve the student (NCC, 1981; Duff et al., 1985; Keene, 1987b, 1989; Sims, 1988; Higgitt and Higgitt, 1993a, 1993b, 1993c; Higgitt, D. L., 1996).

- Self-paced guides to field practice such as Keene (1982) provide a similar approach to learning that can be easily applied to a wide variety of localities.

**Participatory fieldwork**

Participatory fieldwork has the reputation for engaging student attention and deepening the learning experience. However, this is not always true. There is a continuum between staff-led and autonomous work (Figure 2) and it is probable that this also reflects a continuum of engagement on the part of the student, with students who undertake solo project work usually being more committed than those participating in staff-led projects (Tinsley, 1996). The drawbacks to participatory work are threefold: first, that extensive preparation is often necessary to ensure a satisfactory outcome; second, that project work is more time-consuming than the 'Cook's tour' format; and third, that it can be difficult to supervise adequately (for health and safety reasons, if not academic reasons) scattered groups, or worse, individual autonomously operating students (Boud and Feletti, 1991).

- Students are most dependent in staff-led project work. In a typical staff-led project (Cloke et al., 1981), the staff member decides on a project design and allocates activities to the student participants. The methodology and mode of analysis will usually be closely controlled. This can be a useful introduction to participatory fieldwork, and is a fairly common format in the first year. The format is also typical for a field day to support a laboratory-based course, where students take samples in the field which will then be analysed later during practical/laboratory work (Mellor, 1991).
- Sometimes this format enables students to participate in staff research projects. Where students can be given autonomy within a self-contained part of such a project this can be a worthwhile learning experience (McQueen et al., 1990; Purdom et al., 1990), but staff should examine their motives carefully before using student fieldwork to further their research aims. Students should not be exploited and their role should always be acknowledged by the lecturer(s).

- Intermediate between a staff-led project and independent group project work and especially common in the second year of geography and geology degrees (though of increasing importance in the first year) is the staff-guided group project. Here staff help groups of students to formulate a project and offer help with choosing a field area and the selection and application of appropriate methodology (Couch, 1985; Slater, 1993).

- Role-playing project work is an important variant of this approach. Competition between groups may be a useful spur to achievement and may foster enterprise skills (McEwen, 1996b). There can be high educational value in coming to terms with the diversity of viewpoints arrived at by participants in a well-structured role-playing exercise (Harrison and Luithlen, 1983; Gold, 1991; Gold, Haigh and Jenkins, 1993; Slater, 1993).

- In student-led group work, the student group will usually formulate the research design and choose the methodology (Darby and Burkle, 1975). The role of staff is to encourage and to advise on health and safety.

**Learner-practitioner and participant observation**

In human geography and the social sciences, particularly sociology and anthropology, participant observation is an alternative fieldwork format. This can also have its place in physical geography. In human geography, individual students join social groups and participate in their lifestyle. In physical geography, students can, for example, take on the role of environmental manager or consultant, where it becomes known as learner-practitioner activity.

- A variant of participant observation and learner-practitioner activity - work placement - is becoming increasingly common. Students are placed with organisations - commercial companies, charities, government, local and national environmental agencies and planning departments - and work as an employee of the organisation for a period of as little as one week up to a whole year. This can be seen as a new and important format for fieldwork in geography. Most students return from work placements as more mature and responsible individuals. However, certain ethical issues may arise: it is vital that the students are properly supervised and that they are not exploited as cheap labour.

- Cooperative departmental research projects involving both students and staff working together in teams to solve active research problems are another development in this area and provide an analogue for the apprenticeship situation. McEwen (1996a) provides a good example.

**Reference**

# H850 Objectives of fieldwork (Extract 4)


The various objectives of fieldwork grouped under the three general categories identified at the Higher Education Study Group Meeting, 1994

<table>
<thead>
<tr>
<th>1. Subject-specific objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>teaching of specialist field techniques and research methods;</td>
</tr>
<tr>
<td>use of experimental data to solve specific problems and thus illuminate areas of theory and practice;</td>
</tr>
<tr>
<td>the integration of the subject, from theory to practice;</td>
</tr>
<tr>
<td>fostering awareness of other places and cultures ('spirit of place');</td>
</tr>
<tr>
<td>exposing students to a variety of approaches to the discipline;</td>
</tr>
<tr>
<td>providing a basis for independent research by students;</td>
</tr>
<tr>
<td>exposure of students to 'real' research;</td>
</tr>
<tr>
<td>provision of 'real' material and context for a laboratory-based practical course ('live' problems);</td>
</tr>
<tr>
<td>enhancement of analytical and interpretive skills;</td>
</tr>
<tr>
<td>training students in observation, measurement and recording;</td>
</tr>
<tr>
<td>teaching students to use experimental design;</td>
</tr>
<tr>
<td>learning to 'filter' observations and discriminate valuable data from 'noise';</td>
</tr>
<tr>
<td>development of interpretive abilities from both landscape observation and results of problem-orientated fieldwork.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Transferable/enterprise skills:</th>
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<tbody>
<tr>
<td>to provoke students to ask questions and identify problems;</td>
</tr>
<tr>
<td>stimulation of independent thinking;</td>
</tr>
<tr>
<td>development of the motivation and skills to learn autonomously;</td>
</tr>
<tr>
<td>the enhancement of communication and presentation skills;</td>
</tr>
<tr>
<td>development of group-work skills;</td>
</tr>
<tr>
<td>development of leadership skills;</td>
</tr>
<tr>
<td>the improvement of organisational skills such as time/human resource management;</td>
</tr>
<tr>
<td>appreciation of the importance of safety in fieldwork;</td>
</tr>
<tr>
<td>realisation of the parallels between skills involved in carrying out fieldwork and those in employment in the 'real' world.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Socialisation and personal development (the 'hidden agenda' of fieldwork):</th>
</tr>
</thead>
<tbody>
<tr>
<td>stimulation and enhancement of enthusiasm for study;</td>
</tr>
<tr>
<td>development of a respect for the environment;</td>
</tr>
<tr>
<td>encouraging and developing social integration of the student cohort;</td>
</tr>
</tbody>
</table>
enhancement of staff-student relations;
getting to know colleagues;
helping to market the course;
becoming involved in staff research.

References

Few learning environments are as amenable as labs for effective and enjoyable teaching. They allow one-to-one explanations, on demand, in relation to well-planned learning activity, undertaken flexibly at students' own pace. Students doing labs or fieldwork often have much better relationships with their teachers than in classroom-based subjects. However, students' experience of labs is not always positive. There are a number of teaching dilemmas involved.

**Control vs freedom:** Planning is necessary to make practical work manageable, and freedom is necessary to give students scope to think. But if the session is over-planned and controlled then for the students it may become a mindless process of following instructions which makes them totally dependant. If it is too open-ended it can become difficult for you or the technicians to prepare for, or to undertake safely.

**Practice vs theory:** Practical work is often designed to illustrate concepts in action, but the practical demands may squeeze out any discussion of ideas, and lectures are not always well linked to practical sessions.

**Exploration vs demonstration:** What is genuinely experimental may fail to demonstrate particular phenomena or may produce data which cannot be analysed in planned ways. Ensuring that particular topics are demonstrated, or procedures used, may rule out any open exploration.

**Process vs content:** Getting through the content as efficiently as possible may obscure an appreciation of scientific method and the process of enquiry.

You may not be responsible for designing sessions. Indeed the designer of the sessions you demonstrate may not be present during the session or even, in many cases, teach on the course at all. This leaves you with a responsibility for understanding the implications of the designs of particular sessions for the roles you will need to play as a demonstrator. It is common for the design of labs and practical sessions to emphasise control, practice, demonstration, content and dependence. This may place an additional burden on you to compensate in the way you teach during sessions by drawing out at least some emphasis on theory, experimentation and process and fostering student independence even within the tight confines of a planned session.

Third-year students may be able to manage very open-ended work with little supervision, but for beginning students it may be appropriate to start off with a fairly structured approach to keep things from getting chaotic and potentially dangerous. Over time you can gradually loosen up, perhaps encouraging principled variations to planned experiments which might require different apparatus or which address different questions to those posed in the manual.
by Alistair Morgan, adapted by Chris Pegler

The key to effective demonstrating is preparation and being thoroughly familiar with the laboratory, the students, the course, and the equipment and procedures used in each session. You also need to be clear about your role and the extent of your responsibility. When the Open University briefs its Residential School tutors who teach in laboratories it provides them with detailed tutor notes that make explicit what the tutor is and is not responsible for. You are unlikely to be briefed so carefully for each session (though there are likely to be general ‘house rules’) so you will have to find out. In particular, you may need to be clear about the extent of your personal responsibility for safety.

The lab and the technicians

Familiarise yourself with the laboratory. Where is equipment stored? How do you get hold of materials and specimens? Find and meet the technicians whose help you will need; ask them what they will be doing to prepare for the session and if they need your instructions or help.

Familiarise yourself with the layout of the room and the way you will fit the students in and divide them up given the quantity of equipment you will have to work with.

In the field, you may need to visit the site before the students and familiarise yourself with how to get around and things to watch out for.

If you have to give demonstrations, where will you do this so that everyone can see and hear? Will you need an overhead projector or special equipment?

The experiment or practical work

If you have the opportunity, undertake the entire student learning activity yourself, using the apparatus as specified, following the lab manual, recording the data and performing the calculations, exactly as students will need to. Even write it up in the form students will be asked to: this is particularly valuable if you will later mark and give feedback on their reports. Is the experiment or practical task possible to do in the time? Is there enough equipment of a similar enough specification? Which parts of the instructions are unclear or need elaborating?

If you don't have the opportunity to do the entire activity yourself, at least read the manual and handouts carefully and check that you are clear about what is expected. If you have any doubts, ask the lecturer in charge.

What is covered in lectures relating to the session? If the lectures are very closely linked to the experiment, then you may want to attend them so that you can remind students of ideas and explanations they should already have heard. If you cannot attend, or if they are not strictly relevant, then check on the background reading you would expect students to be familiar with. You may need to refer students to particular pages during the session.

Handouts and briefing

Students will probably have a manual or extensive handouts containing instructions for the session. Get hold of all handouts and check that they cover what students will need. You might need to produce an additional handout on the use of a new technique or procedure or to prepare a mini-lecture or demonstration of a new skill that is required, to compensate for an omission. What oral briefing about the conceptual background might you need to give at the start, given what students should already know?

Equipment and demonstrations

Familiarise yourself with the equipment or apparatus and procedures involved. Make sure that you could assemble and disassemble it and diagnose and correct likely problems. If the demonstration equipment failed to function, what would your back-up plan be?

If you need to demonstrate the equipment, procedure or skill, practise doing this. How much detail will it be sensible to go into, given what students already know how to do? How long will you need? It may be worth practising with a colleague and timing yourself. Will you need specimens, materials or sample data for this demonstration?

Activity: Demonstration review

Review a session in which you will act as a demonstrator and answer these questions.

About the session

1. What are the main aims of the session? What happened in the previous week and what will happen next week?
2. What theoretical background is involved? Do you need to know more about this?
3. Could you undertake this experiment or practical work yourself? What might you need more technical familiarity with?
4. Will you be marking students’ reports? If so, what should you brief them about that you will be looking out for in their reports?
5. What safety issues are raised by this session to which you should pay special attention?
### About the students

1. What will students know about this topic? What might they appreciate additional explanation about? What do the students need to prepare beforehand?
2. What familiarity will students have with the equipment or procedures involved? What might they need a demonstration on?
3. What might cause students difficulty?
4. What will the students need to do afterwards?
Familiarise yourself with the equipment or apparatus and procedures involved. Make sure that you could assemble and disassemble it and diagnose and correct likely problems. If the demonstration equipment failed to function, what would your back-up plan be?

If you need to demonstrate the equipment, procedure or skill, practise doing this. How much detail will it be sensible to go into, given what students already know how to do? How long will you need? It may be worth practiseing with a colleague and timing yourself. Will you need specimens, materials or sample data for this demonstration?

Activity: Reviewing a session

Review a particular session in which you will act as a demonstrator and answer these questions.

About the session

1. What are the main aims of the session? What happened in the previous week and what will happen next week?
2. What theoretical background is involved? Do you need to know more about this?
3. Could you undertake this experiment or practical work yourself? What might you need more technical familiarity with?
4. Will you be marking students’ reports? If so, what should you brief them about that you will be looking out for in their reports?
5. What safety issues are raised by this session to which you should pay special attention?

About the students

1. What will students know about this topic? What might they appreciate additional explanation about? What do the students need to prepare beforehand?
2. What familiarity will students have with the equipment or procedures involved? What might they need a demonstration on?
3. What might cause students difficulty?
4. What will the students need to do afterwards?
H850 Briefing demonstrators

by Alistair Morgan

You may have responsibility for leading a session in which you are supported by demonstrators and you need to brief them. The best way to prepare for such a briefing is to imagine yourself as a demonstrator and to ask yourself what you would want to know.

**Activity: Preparing to brief demonstrators**

Draw up an outline of a briefing for a particular session where you will be supported by demonstrators.

1. When would you want to meet them, and where?
2. What documentation would you want them to have seen?
3. What equipment would you want them to be able to demonstrate?
4. Are there particular skills or procedures that you might need to demonstrate to the demonstrators?
5. What concepts or content would you want them to be familiar with?
6. What would they need to know about related lectures or other parts of the students' learning experience going on in parallel?
7. What would you expect them to do during the session?
8. What problems might be encountered during the session?
9. What responsibility would they have for safety?
You may have formal responsibilities at the start of each session, such as checking the equipment, making specimens or materials available, taking a register, or checking in with the lecturer in charge. This advice goes beyond these formalities.

The first session

The first session is an opportunity to familiarise students with the lab - its layout, where safety equipment is located, where chemicals, specimens or additional equipment may be obtained, where the lab technician is located, and so on.

As with the first lecture, the first lab can be used to give an overview of the whole sequence of labs and how each experiment links with the whole.

Students will need to be provided with lab handouts and written instructions, informed about appropriate textbooks for background theory and manuals about equipment or procedures. They should be left in no doubt about what preparation is expected for each session.

Finally, students will want to know about assessment. What kinds of reports are expected? How will they be graded? What are the deadlines? What happens if students miss a session or their experiment fails and they have no data? Where students work together in teams, what is the policy on shared, or very similar, reports?

Students

How friendly and approachable you are may matter more to students than any other aspect of your demonstrating, such as your skill or knowledge. Meet and get to know the students you will be working with. The likelihood of them asking for your assistance will be greatly increased if they have already talked with you socially or informally. Introduce yourself and, if you can, learn their names. At the start of each session greet them and casually check that everyone in each group is present and that they have a copy of the handouts they need. Until the session is formally introduced, sit or stand among the students rather than to one side or out at the front.

Debriefing the previous week

Students often perceive lab sessions to be compartmentalised, each an isolated free-standing event rather than part of a logical sequence. They may completely forget about a lab the moment they have handed in their report. You can help to maintain a coherent perspective by undertaking a debrief of the previous week's work. Depending on how much time you have, any of the following might be appropriate.

- Ask each group of students informally if there were problems writing up the previous week's report, or if they have any questions.
- Ask about what they did during, or have learned from, previous sessions or experiments and whether this might help them to undertake today's session.
- Ask the students to bring their reports with them; set them in pairs to read each other's reports and offer constructive feedback. You can use a model report or feedback checklist to guide the way they do this.

Briefing

There may be a lecturer in charge who does a briefing at the start of the session for you. This briefing may include all of the elements listed below, some of them, or none. It is worth finding out what such a briefing is likely to contain so that you know what to prepare for - you may have to fill in any gaps yourself. Briefings may include:

- the purpose of the session;
- how it relates to lectures, other sessions or other material students are tackling on the courses;
- background knowledge, including theory, principles and scientific methods issues;
- how the session is organised, in terms of the size of sub-groups, how long things will take, the way groups rotate around equipment or experiments;
- the use to be made of handouts containing instructions, data recording sheets or supplementary background material;
- safety issues - for example those involving hazardous substances or potentially dangerous equipment;
- your role, and what you will be doing to support students;
- what students are expected to record and write up, and whether this is assessed or discussed at any future point.
This is quite a long list! Labs, practicals and fieldwork tend to have more supporting handouts and instructions than almost any other teaching situation, partly in order to reduce the burden on this initial briefing. There is also a limit to what students can take in and remember during a briefing at the outset and that is why demonstrating takes the form it does - supporting students throughout a session. Briefings are therefore best kept short and focused on the purpose and overview, rather than on details which can be handled either in handouts or through interaction as the session progresses. Plan the briefing as you would a mini-lecture.

After any briefing, ask students if they have any queries. Judge whether what the students raise are general or idiosyncratic issues; if they are the latter, sort them out with the individuals concerned, one-to-one, so that everyone else can get on.
H850: Demonstrating procedures and skills

by Alistair Morgan

Students may need to know how to use equipment, take measurements, conduct experimental procedures, locate information sources, or record and analyse data. Showing them, in a demonstration, is the usual way to start students off. However, demonstrations can be difficult to perform well.

- Make sure everyone can see the demonstration and hear you. Directly ask someone at the back whether they can see and hear.
- Labs, libraries and workshops are often difficult spaces to work in with bad acoustics, so you may have to move students and even furniture.
- If the physical space is unsuited to a large-scale demonstration you may have to do more than one demonstration with smaller numbers, or do the demonstration for one student from each group who then repeats the demonstration to their group.
- During fieldwork it can be very difficult to demonstrate to more than a few at a time, especially out of doors in windy conditions, and it may be better to do most of the briefing in advance.
- If it is very difficult for students to see, consider using a visual aid so that you can show an enlarged or simplified version - on a slide or on video.
- Repeat crucial stages or tricky procedures.
- Talk all the time you are demonstrating so as to focus attention on exactly what you are doing, especially when it is difficult to see: 'Notice how I am keeping a gentle pressure on the burette tap as I turn it, to stop it from coming out of place ...'
- Check that students have watched and understood by asking questions.
- Check that students can actually do it for themselves: 'Can you show me how you would use the micrometer with this sample? ... Is Mohsin doing that right? ... Would anyone else like to check that they can do it?' This may be particularly important out of doors when group demonstrations are less effective.
- When you ask students to demonstrate back to you, ask them to talk you through it so that you know that they understand what they are doing.
- Engage students’ thinking as well as their attention: ‘What would happen if I turned the micrometer main shaft instead of the small knob on the end? ... or ran the micrometer onto the sample quickly?’
- Keep demonstrations of detailed skills as short as possible. Longer demonstrations may be effective for understanding of concepts or principles.

Demonstration may involve close physical proximity to students or even direct physical contact, for example guiding a student’s hand. This may feel threatening for some students and may break cultural or religious conventions for others. You will need to show sensitivity. Problems can be minimised by explaining what you intend to do and why, checking that the student is happy to continue and putting no pressure on a student who is unhappy. In some circumstances, it may be necessary to find a more appropriate demonstrator.

Sometimes it is more effective for students to become familiar with equipment and procedures before they go into the lab. Your department may be able to set up equipment in a small room where students can practise and get assistance from a technician or demonstrator on a one-to-one basis. The demonstrator may be asked to sign that they have seen the student use the technique safely before the student is allowed into the lab.

Many demonstrations also involve conceptual change, as what students see depends on what they expect and already understand. You may need to develop their understanding before they can see what is going on in your demonstration.
You have probably experienced being given a set of instructions and not having a clue what to do a moment later - for example when someone gives you directions in a strange town. Being able to give clear instructions that can be followed accurately is a valuable skill. Table 3.1 lists the most common faults when giving instructions, and what you might say instead.

**Table 3.1 Common faults in giving instructions**

<table>
<thead>
<tr>
<th>Common faults in giving instructions</th>
<th>What you might say instead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diving straight into details without giving an overview</td>
<td>'What we are trying to do here is... and it involves three components done in a particular order.'</td>
</tr>
<tr>
<td>Assuming either too much or absolutely no background knowledge</td>
<td>'Who has done one of these before?', 'What do you already know about this from your lectures?', 'If I use any terms you are not familiar with, stop me and I'll try to explain.'</td>
</tr>
<tr>
<td>Going into too much detail</td>
<td>'The detailed instructions are in your manual. If you have those open in front of you I'll just highlight the main things to watch out for.'</td>
</tr>
<tr>
<td>Giving a very long list of instructions</td>
<td>'I'll break this up into three sections: setting up the equipment, calibrating it, and recording the data. I'll come back and help you to calibrate it after I've checked that you have set it up correctly.'</td>
</tr>
<tr>
<td>Not summarising at several points</td>
<td>'So at this point you would have got the results from the first experiment and checked against your predictions before going on to the second experiment.'</td>
</tr>
<tr>
<td>Not checking for understanding</td>
<td>'If the graph you plot looked like this, what would that mean?', 'Has anyone got any queries?'</td>
</tr>
<tr>
<td>Not repeating crucial information</td>
<td>'Let's just go over that bit again...'</td>
</tr>
<tr>
<td>Making it a monologue instead of an interaction</td>
<td>'What do we need to do next, and why?'</td>
</tr>
</tbody>
</table>

Instructions seem particularly hard to follow when they involve computers. Those who are thoroughly familiar with computer operation can easily underestimate how complex and multi-layered their expertise is and how difficult it is for novices to understand and follow even apparently straightforward sequences of operations. Extra care may need to be taken about:

- using computing terms the students are not familiar with;
- assuming students can already do things that they cannot;
- going too rapidly through too many steps (or screens or windows) which may seem unimportant or simple to you but can easily trip up students when they try to follow you;
- making a decision faster than students can understand how you did it, so that, faced with the same decision on their own, they are stuck;
- providing detailed technical explanations of aspects of the task which are not central or necessary, especially when these are at the next 'layer' of complexity beyond the task at hand. When aspects of computing are explained to me I find it very difficult to judge what I really need to know and what is background.

The best check on whether you have perpetrated these crimes is to ask a student to demonstrate back to you, there and then, that they can follow your instructions unaided, talking you through each step as they take it. You can add detail or elaborations once students have managed the basics.

In the library, instructions about information retrieval can seem to students obvious or uninteresting until they have tried to use particular techniques with particular information sources and discovered what the difficulties are. Students often need to gain some first-hand experience before they pay serious attention to detailed instructions. Successful 'demonstration' sessions are often multi-phased - with short explanations interspersed with activities and de-briefing.
Long explanations can resemble short lectures and do not necessarily work as well as you might hope. Research evidence about the effectiveness of lectures highlights the weakness of lectures for developing skills, and the importance of note-taking for student learning.

**Activity: Ask your students for feedback**

Show the above list of 'common faults' in giving instructions to a student in a group to which you will be giving a fairly full set of instructions. Ask them to use it like an observation schedule and note down what you did and did not do.
Depending on the way your labs or fieldwork are organised, you are likely to have some responsibility for safety. You need to be clear how far this responsibility extends.

**Familiarise yourself with facilities**

Check where fire extinguishers and other safety equipment are located and that you can operate them. Ask the technician to show you how flume cupboards or other such safety-related equipment functions. Make sure you can quickly lay your hands on emergency telephone numbers, such as fire and first aid. Check evacuation procedures and that you would know what to say in the event of an accident, or, in the field, in the event of an emergency. On field trips, check the first aid box and who has been trained in first aid.

**Familiarise yourself with the session**

When you prepare for each specific session, do a quick mental safety check. What could be hazardous? What additional briefings or demonstrations might students need? What points in the session might require extra vigilance?

**Brief students, demonstrating if necessary**

Make sure students are aware of potential hazards and can undertake hazardous operations safely. This might require additional or repeated demonstrations, or you may want to ask students to show you that they can undertake particular operations safely.

**Remind students**

Students forget and can be over-casual until they are more experienced. Remind them. Take over an operation to demonstrate it correctly if you spot a potential problem. In the field, remind students before they get into potentially hazardous situations.

**Enforce rules**

If you see a clear breach of safety rules, such as smoking, eating or running, intervene immediately and develop a sense of respect for strict adherence to rules.

**Accidents**

Despite careful planning and safety checks accidents will still happen, if rarely. Be prepared for the worst by thinking in advance about what the most hazardous aspects might be and what might go wrong so that, if necessary, you can act very quickly.

Read any specialist advice that applies to your context (such as [COSHH (The Control of Substances Hazardous to Health Regulations 2002)](http://students.open.ac.uk/desktop/h850-05k/files/demonstrating.zip/demo_app7.htm) procedures). If you have any worries about safety in a particular session or field trip, and the extent of your responsibility for safety, discuss them with the lecturer in charge beforehand.

After any accident, you may need to call in someone trained in first aid (and of course you need to know how you do this). Finally, you will need to record any incident in an accident book, which will probably be held by a technician.

You may find relevant information on the institution’s intranet, such as relevant procedures and the names and contact numbers of first aiders or local hospitals, eg. the comprehensive health and safety site at [Kingston University](http://students.open.ac.uk/desktop/h850-05k/files/demonstrating.zip/demo_app7.htm). Find time to review this information and make a note of phone numbers and names.

**Check the state of the lab at the end of the session**

When the session has finished, ask each group of students to leave their equipment and working area in a safe state. After they have left, check the lab thoroughly.

**Activity: Student safety audit**

Ask your students, in an appropriate session, to undertake a brief safety audit of the lab, the immediate working environment or the main session activity, in order to tune their attention to safety issues.

You can ask each group simply to look around for potential safety problems, or safety equipment or design features related to safety, giving them just a few minutes to draw up a list. Then ask each group in turn to contribute something from their list that you write up on the board.
Continue until all groups' items have been listed. Comment on items that need elaboration and add any items they have overlooked.
There are powerful social mechanisms operating that mitigate against students asking questions or requesting help. Students may either not like to admit, or they may not even recognise, that they have problems. If you simply stand on one side or out at the front, waiting to be approached, you may find yourself with little to do or only interacting with the most outgoing of students. Until students know you well or feel confident in their own ability, you are likely to have to take the initiative. This is an equal-opportunities issue as some students, due to their background or culture, will be less likely to admit failings or seek assistance.

Alternative strategies for getting involved include:

- **Spotting problems and intervening**
  You can watch carefully and move in when you think there is a difficulty: for example, one student's experiment might be way behind schedule. Potential safety problems are an obvious prompt for intervention. One difficulty here is that your interventions may be perceived as threatening as they publicly label a failure of some kind, and students do not like being closely observed.

- **Touring**
  You can simply circulate, stopping and talking with each student in turn, and spending as much time with each as they want. Because everyone gets their turn your visit need not be perceived as threatening. You will inevitably spend longer with some than with others. Try to avoid either targeting or avoiding individuals. If you ask: 'Got any problems?' you will get a predictable and unhelpful answer. If you say: 'Tell me where you have got to and what you are going to do next' then the largely descriptive answer will throw up possible points of discussion and may reveal where you can be helpful.

- **Scheduling interventions**
  If you tell students in advance when you will be coming round, just to check everything is OK, then your entry into a group will be expected and easy. For example: 'Today's session is in three parts. I'll be coming round at the end of parts 1 and 2, as soon as I see you have finished.'

- **Establishing checkpoints**
  You can ask students to call you in to check their equipment, or to check their data, at crucial points. This is like scheduling interventions except that students have to take the initiative. An alternative is to require students to come to you at a certain point to collect additional equipment, or samples, or the handout for the next stage of the session. You can use this moment to check on progress. You may want to keep a log of those whom you have seen and those you have not.

- **Visiting groups rather than individuals**
  Approaching a group is easier than approaching an individual and once you have arrived in a sub-group it is less public, and so less difficult, for an individual to ask a question or to ask you for help.

- **Intervening with the whole class**
  Sometimes you will encounter a problem that everyone is experiencing, or you will make an observation that everyone would benefit from. You can then attract everyone’s attention and give a quick explanation around the blackboard or around one of the students' experiments. For example: 'Amanda here has already reached the second stage and she has discovered that it is difficult to take these readings unless you do it like this ...' Such interventions can be disruptive to students' work if over-used.

After you have had several organised encounters with each student, it is much more likely that they will simply call on you when needed.

**Activity: Logging your student contact**

During your next demonstration session, keep a clipboard handy and draw yourself a map of the lab and the positions of all the students. Make a note each time you talk one-to-one with a student.

1. What pattern of interaction emerges?
2. What does this tell you about your strategy for getting involved and supporting all students?
3. What else might you do to make your interventions more even and frequent?
While some students might not want you to intervene and will deny they have problems or avoid eye contact, others would be happy for you to take over and do the whole thing for them. Some students may simply want to get on and finish the tasks they are facing. Your educational goals might be quite different and you are not obliged to do what students want you to do.

Alternatives to simply answering students’ questions or solving their technical problems for them include the following:

- Lead students through to a solution with a series of questions.
- Deal with it as a problem-solving situation: ‘What hunches do you have about what is going wrong here? ... How might we test that possibility?’
- Show that you expect students to be able to manage next time, by demonstrating how to solve their equipment problem and then returning the equipment to its original, problematic state, for them to sort out again on their own.
- Encourage independence by asking students to read the practical manual first and to call you back only if that does not sort out the difficulty.
- Encourage collaboration by asking the students’ colleagues how they would tackle the difficulty, or how they have already completed that part of the practical. For example: ‘Mary, you have just completed this section. What exactly did you do at the point Brian has got stuck at?’
- You can even say: ‘What advice do you think I am going to give you?’ It is amazing how often students already know but do not have the confidence to act on their own!
Teams can achieve more than individuals, tackling more complex experiments, and collecting and analysing more data. But while students very often undertake practical and laboratory work in groups this is often for resource reasons – to share equipment and save time. Students do not always work well as a team. They may develop specialist roles that limit their learning. For example, they may rely on one team member to do the maths and another to explain the theory every week, or divide tasks in such a way that someone is left with little to do for much of the session. Students can become very proficient at helping each other out and tackling problems independently, and the acquisition of teamwork skills is often an aim of practical work. But they may need some help to become so proficient.

To encourage teamwork and collaboration:

- Ask groups of students, at the start, how they are going to work together, and ask them, halfway through, to review how well it is working out.
- Ask the group that finishes first to tell the others how they managed it.
- Deliberately rotate roles, for example allocate data recording and analysis roles to a different student each week.
- Refer problems encountered in one group to another group for solution.
- Have only half each student group in the lab at once, switching over halfway through so that the first half have to explain to the second half what they have been doing and what needs doing next. Students soon find that they have to prepare well, get themselves organised and trust each other to handle this.
- Pool data where a number of students are collecting the same data in parallel, or compare data where students are using different techniques. Students are often fascinated to discover whether others have the same results as they do.

When students share facilities, whether sharing terminals in a computer lab or a piece of equipment in the field, equal-opportunities issues can easily arise. Those less socially confident may hang back and not get their share of ‘hands-on’ experience or get as involved when decisions are being made. Students with a disability may find be less dextrous in handling equipment, or slower in recording findings. As a demonstrator, you may need to establish ground rules to balance out involvement and experience across each group of students, for example through planned turn-taking: ‘In this experiment on reaction times I’d like you to organise yourselves so that each of you in turn sets up the computer display, briefs the subject, takes the measurements, and records the data, for each of the four stages of the practical. Each of you should then have experienced each role.’ You may also need to intervene in some groups: ‘Can I just check that all three of you have had an opportunity to tackle one of these programming problems? Would you like to lead on the next one?’

**Activity: Encouraging teamwork**

Devise a way to turn what was previously an individual experiment or task into a group task in such a way that students will benefit and learn about teamwork.

Try this out and ask students what they thought they gained or lost by doing it collaboratively.
Developing observation

by Alistair Morgan, adapted by Chris Pegler

Traditional fieldwork sometimes involved demonstrators pointing things out as students gazed in the general direction while wondering what they were supposed to be looking at.

Demonstrators can help to develop students’ ability to observe and see what an expert can see by the following:

- Engage students in tasks that require acute observation to be exercised: recording, comparing and analysing in specified ways towards the completion of a task or project. Sometimes this is taken too far and students are so busy recording data that they hardly notice what is in front of them.
- Encourage students to work collaboratively so that they compare observations and talk about what they can see. It is often through realising that others see things differently that more acute observation is developed.
- Tune in students to what they might see beforehand through video or slide presentations, models or simulations, so that they are primed to pay attention to particular features.
- Require students to provide accounts and give presentations afterwards based on observation.

Activity: Encouraging observation

Look at the four suggestions above for improving observation and compare them with your own practice:

1. Which, if any, of these do you currently use? How successful do you find these at developing observation in your students?
2. Are there any of these suggestions which you do not currently use? If so, consider how you would use this to improve one of your existing demonstrations.
3. A drawback to observation is suggested, that of putting too great an emphasis on recording data. What might be the drawbacks (if any) of the other three suggestions: to encourage collaborative working and comparison of observations, priming students beforehand using multimedia resources, or requiring students to give presentations or accounts?
H850 Handling problem situations

by Alistair Morgan, adapted by Chris Pegler

Problems during demonstrating and fieldwork can occur for a variety of reasons, caused by equipment, people or a combination of these two. Here we suggest how you might resolve some of the most common problems and understand why they have occurred.

Faulty equipment

This geological microscope is broken.

Students frequently report that their equipment is faulty. You need to know how to check faults and get hold of replacement equipment at short notice. But what students sometimes mean is that the equipment isn't working as they expected. They may have set it up incorrectly or may be using it incorrectly. Ask them to show you how they set it up and how they were using it. The ideal educational outcome may be that they can diagnose faults and inappropriate use for themselves, or that they know what not to do next time, rather than that you have sorted a specific technical problem for them.

There may be a safety issue involved, in which case it might be wise to seek the assistance of a technician. Don't assume that you have to sort every technical problem yourself – with some equipment, it may be sensible not to try. Technicians may ask you not to attempt to mend things yourself.

Failed experiments

It’s not working – the results are all wrong.

Mishaps occur all the time – don’t panic. Treat them as a learning opportunity and work with the students to try to find out what has happened and why. Check that instructions and procedures have been followed, readings taken correctly and recorded in data sheets, and interpreted, correctly.

If it is not an isolated problem, and the instructions or the experimental design are at fault, it may affect all students, so alert the lecturer in charge straight away.

If the work has to be abandoned, you may have to negotiate the design of an alternative or shorter experiment or come to an agreement about what will be written up from the work already completed.

Interpersonal problems

John is doing damn-all to help.

If students are arguing or not co-operating in a group, don’t get involved in a dispute or take sides. You will not know about the background to the problem and it is not your business. Instead, be task-oriented. Concentrate on organising students so that each has a role in getting the job done. This can be more socially acceptable and less awkward. You may need to make a note about how groups might be organised differently in subsequent sessions, or about how to brief students in future about dividing tasks up.

Wandering students

There may be rules restricting free movement within a lab, or about going off on your own during a field trip. Students may be on their own for a variety of reasons: they may have finished, their group may have disowned them, they may be stuck or just bored, or they may be helping another group. Wandering students may be a safety hazard, disruptive to others, or no problem at all. It may be sufficient to remind students of the rules. Find out what the student is up to: ‘Is there a problem preventing you from getting on with your work?’ If there is a safety issue, act decisively. If the student does not respond and causes any disruption, alert the lecturer in charge.

Activity: Recording and managing your problem incidents

1. Describe a problem incident you fear might happen: for example power failure to half the benches in the lab or a third of the class not returning after the coffee break. Exactly what would you need to do to tackle it?
2. Check with a more experienced colleague how they might tackle this incident.
3. If you have already tackled an incident of this kind, and you are collecting evidence of competence for accreditation, an account of it could be used in your portfolio.
H850: Closing the session

by Alistair Morgan, adapted by Chris Pegler

Summarising

Lab and practical sessions can feel chaotic and fragmented and students often want to rush off the moment they have finished. They can greatly benefit from 'closure' - linking the components of the session together in a summary and reinforcing the learning points. There are a number of ways to close a session.

- Prepare a 'mini-lecture' beforehand, perhaps accompanied by a handout, and plan to allocate the last five minutes of the session for this summary. It can be descriptive, simply listing what has been done, or more conceptual, lifting students from the procedural detail to general and theoretical points.

- As you observe students working, make brief notes of the points you might highlight at the end, basing an impromptu summary on these notes: "There've been a number of things I've noticed which seemed interesting and important ..."

- Invite students to summarise for themselves by asking: 'What are your observations about the procedure, about your results, and about the underlying theory?'

You can gain students' attention by orienting this summary to assessment, asking: 'What are the main things your reports should include from this session?' or: 'What am I likely to be looking out for in your reports?'

Briefing for follow-up tasks

After a practical session, students may well need to do additional work, such as analyse and interpret the data they have collected, read associated theoretical material, or write up a report. They may also need to prepare for the next session. Make a point of giving a short briefing at the very end of a session on what work still needs doing, so that students see the session as part of an ongoing study rather than as a self-contained, finished activity.

Record-keeping

You may be required to keep a register of who was present or even who completed the experiments or tasks. In some departments, demonstrators also carry a clipboard on which they record observations about students' behaviour and performance in the lab that are used to moderate marks for lab reports.

You may also be required to make a record of the condition of equipment or of the quantity of materials or specimens returned to stores.

Activity: Closing the session

1. What do you usually do to mark the closing of your demonstration sessions?
2. Of the ways to close a session suggested above, choose one that's different from your usual practice and try it out at the end of one of your sessions. For example, if you usually control the summary or closure of the session yourself, consider giving this role to your students, or vice versa.
3. What types of demonstration would you feel that this was most appropriate for? What types of demonstration (that you are involved in) would it be inappropriate for?
H850 Reviewing your own demonstrating

by Alistair Morgan, adapted by Chris Pegler

To allow you to get a measure of the effectiveness of your demonstrating work, you might ask a colleague to use a formal observation schedule in observing your demonstrating or ask your students to complete a student feedback form.

Part of a self-review checklist for feedback is shown below. You could use or devise a list like this to review your own demonstrating.

<table>
<thead>
<tr>
<th>How well did you ...?</th>
<th>Very well</th>
<th>Well</th>
<th>Adequately</th>
<th>Poorly/Not at all</th>
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<tr>
<td>Understand the session and what needed to be done</td>
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<td>Know how to set up and use the equipment</td>
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<td>Understand the theory/principles underlying the session</td>
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<td>Provide a clear briefing at the start</td>
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<tr>
<td>Provide help to students whenever they needed it</td>
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<tr>
<td>Understand students’ varied difficulties</td>
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<tr>
<td>Explain ideas and procedures</td>
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<td>Solve students’ problems</td>
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<tr>
<td>Operate in a patient and supportive way</td>
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<td>Help students to do things for themselves rather than taking over</td>
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<tr>
<td>Provide a clear summary at the end</td>
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Activity: Reviewing your demonstrating

1. Complete the above checklist from your own perspective.
2. Then frame each of the questions so that they can be used by your students and/or an observer as a feedback form.
3. Compare their responses with your own. Do your self-perceptions match the student/observer perceptions?
4. To make the feedback more useful would you reduce, extend or vary the questions asked? If so then create your own amended version.

If you found the feedback useful then consider how frequently you would wish to use such a feedback form with your students and how you would act on the responses.
Further reading (Demonstrating)

by Alistair Morgan

This thorough book deals with the design and organisation of laboratory work, assessment and monitoring. It includes case studies and references to much of the literature on laboratory teaching.

Based in studies of laboratory teaching this chapter considers the aims of labs and the skills demonstrators need.

This practical manual was written for part-time teachers at the University of Edinburgh and includes a section on problem classes and a useful list of resources.

This open-learning guide addresses the aims of labs, the design of individual lab sessions, assessment of lab work and strategies for increasing independent and co-operative learning in labs.

This collection of exercises and activities is a useful source of ideas and materials for improving students' written communication in lab and fieldwork reports and developing an understanding of the nature and language of science.

This is a concise practical introduction for teaching assistants.