

## Unit 2: Working in the Science Industry

NQF Level 3: BTEC National

Guided learning hours: 60

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### Unit abstract

We continue to encounter many scientific challenges and at the centre of them all is the understanding and skill of the laboratory science technicians who work in a variety of places and scientific disciplines. The most important driving force in their success or failure will be how their laboratory is organised.

Laboratory technicians need to have a good understanding of how each of the specialist laboratories have individual requirements and also have generic procedures and practices. An understanding of safety regulations and the application of laboratory management information systems are essential. These combine to give an appreciation of how to run an efficient, effective and safe laboratory. This unit is crucial in underpinning the training of a science laboratory technician.

The unit starts by exploring the essential procedures and practices found in all laboratories. This is supported by a look at specialist laboratories. They are examined on their different individual requirements in terms of efficiency, effectiveness and safety. This unit gives learners an appreciation of how scientific data and records are kept in a modern laboratory information system. Finally, the unit provides an essential insight into how laboratories are organised today in the light of up-to-date safe working practices and safety regulations.

### Learning outcomes

On completion of this unit a learner should:

- 1 Know how procedures are followed and information passed on in the laboratory
- 2 Understand the design of a workplace with respect to its efficiency, effectiveness, safety and security
- 3 Understand laboratory management information systems and a range of scientific computer applications
- 4 Be able to demonstrate and understand safe working practices in the laboratory.

## Unit content

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### 1 Know how procedures are followed and information passed on in the laboratory

*Procedures:* chemical store management; ordering procedures; calibration of equipment eg pH meters, Pasteur pipettes; servicing equipment eg burettes and Bunsen burners; collection/transport of substances and equipment for disposal; use of centrifuges; instrumentation techniques eg colorimeter, electrophoresis; desiccators and vacuum storage; handling and disposal of radioactive substances; handling and use of glassware; handling of solvents and poisons; use of ovens; operation of the fume cupboard

*Communicating practices:* lines of authority and accountability to and from other personnel; working as a team; organisation of the laboratory (weekly, daily, etc); routines (work schedules, briefings); reporting of results

### 2 Understand the design of a workplace with respect to its efficiency, effectiveness, safety and security

*Design:* identify the key features necessary in a laboratory (services, furniture, access, safety equipment, fume cupboard, storage, workspace)

*Specialist laboratories:* biological eg microbiological laboratories; chemical; physical sciences; research facilities

*Safety requirements:* materials; radioactive substances; specialist equipment; health and safety requirements; waste disposal; toxic and flammable substances; storage; specific safety equipment and clothing; security

### 3 Understand laboratory management information systems and a range of scientific computer applications

*Scientific data storage:* COSHH records; scientific data; scientific apparatus records; waste disposal records; health and safety checks; training records; quality assurance data; report records; specification levels; sample throughput and managing; security, Data Protection Act

*Workplace records:* stock records; work schedules; servicing dates and contracts; laboratory test data; specimen records; test records; calibration records; validation data; standard operating procedures

#### 4 Be able to demonstrate and understand safe working practices in the laboratory

*Definitions:* risk; hazards eg harmful, toxic, flammable, oxidising agent, reaction with water to give flammable gas

*Risk assessment:* need for; carried out for every practical activity; minimisation of risk; action to be taken when incidents occur

*Sources of information:* CLEAPSS hazcards, manufacturer's data sheets, MSDS; good laboratory practice eg quality standards, UKAS BS 17025, BS EN ISO 9001

*Regulations and legislation:* COSHH regulations; HSE inspectors; UKAS assessments; other relevant regulation/legislation

*Safe working practices:* fume cupboard storage; waste disposal; incident and accident procedures; risk assessments; COSHH register; good housekeeping eg safe handling of pathogens; protective equipment eg laboratory coat, protective gloves, goggles, visor, protective shoes, protective glasses

## Grading grid

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all of the learning outcomes for the unit. The criteria for a pass grade describe the level of achievement required to pass this unit.

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 describe procedures and practices undertaken in a laboratory and how they can be communicated	M1 demonstrate evidence of documented procedures that you have used in the laboratory	D1 explain and analyse why laboratory procedures and practices must be communicated in a laboratory
P2 identify key features in the design of a specialist laboratory	M2 design a specialist laboratory and justify its individual key features	D2 analyse why good laboratory design is important for efficiency, effectiveness and safety
P3 identify the scientific data that may be stored and recorded in a laboratory	M3 describe the procedure for storing scientific data and necessary records in a laboratory management information system	D3 explain the advantages gained by keeping data and records on a laboratory management information system
P4 demonstrate safe working practices in a laboratory and describe their regulation.	M4 explain how safe working practices in a laboratory are regulated.	D4 explain why working practices in a laboratory are regulated.

## Essential guidance for tutors

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### Delivery

A visit to an industrial state-of-the-art laboratory is strongly recommended. If this is not possible for all learners, then tutors are strongly advised to take any opportunity to visit one themselves. This would give tutors an appreciation of the differences between industrial laboratories and centre-based laboratories to enable them to better deliver the unit. Such differences include the clear demarcation of 'clean' and 'contaminated' areas (not only in biological and animal laboratories, but even in many chemistry ones), and the separate space for computers, desks etc that learners may not be aware of.

In delivering this unit it is essential that the learner be enthused, motivated and stimulated by performing experiments and following procedures in the laboratory. Varied and interesting experiments or exercises can teach the proper use of laboratory equipment. Key laboratory skills can be developed in this way by concentrating on a practical teaching approach.

The importance of health and safety regulations should be strongly stressed when undertaking all practical teaching. The learner should be encouraged to risk assess each practical exercise they undertake.

Reports should be written at every opportunity. The recording of all practical work should be written in a hardback practical laboratory notebook by every learner.

The use of industrial visits should be encouraged to enlighten the learner about laboratory organisation in a range of scientific workplaces or laboratories. This will enforce the relevance of the unit.

Learning outcome 1 delivery could consist solely of completing and recording a number of practical exercises. Industrial visits and guest speakers would also greatly enhance the experience.

Learning outcome 2 should be delivered in a way that makes the learner fully aware of how the environment in which they find themselves affects their effectiveness, efficiency and safety. Well-designed specialist laboratories promote their own efficiency and effectiveness for their intended use and purpose. These factors together promote safety for everyone, and security for staff and information.

Learning outcome 3 brings together the purpose of a laboratory to produce results from scientific investigations and procedures. It should make the learner aware that these results have to be recorded and stored for future reference. Modern laboratories all employ laboratory management information systems (LMIS) to record this information, and have security systems in place to protect it.

Learning outcome 4 addresses the safe practice of performing procedures and experiments in the laboratory. The learner should be made aware of all current regulations.

All four learning outcomes can be delivered to the learner in creative and stimulating assignments to promote successful learning.

Studying blood and other bodily substances is not a banned activity (unless an employer has provided written instructions restricting the activity). A risk assessment **must** be carried out. For further guidance refer to page 497.

## Assessment

All the pass grade criteria must be met in order for a learner to achieve this unit.

For P1, learners will be expected to describe the procedures commonly used in a laboratory. Learners will be expected to cover the procedures listed in the unit content, and then decide how each can be communicated. Evidence for this could take the form of a compiled list with accompanying short notes, a leaflet or a PowerPoint presentation.

P2 requires learners to describe key features of a laboratory in terms of the design of a specialist laboratory. Guidance on the design of specialist laboratories is expected to have been covered in the unit content. The criteria could be assessed by producing a leaflet, descriptive list or PowerPoint presentation.

For P3, learners can compile lists on the scientific data that can be recorded and stored in a laboratory. The learner should stress the need for its storage on an LMIS. Alternatively, tutors could give the learners a prepared list of scientific data and ask them to decide which sets of information could be stored on an LMIS and which could be placed on a workplace record system. Due to the enormous size of material in the unit content, tutors may confine themselves to choosing specific types of data or records. Again, tutors must acknowledge the need for security and must give some examples, but a catalogue-style presentation is not appropriate.

P4 requires learners to show safe working practices and their understanding of relevant current regulation. The tutor could again write a specific worksheet for the assignment, to which the learner would apply the unit content to match working practices to their appropriate regulations. The opportunities for the learners to design leaflets or produce PowerPoint presentations should be strongly encouraged.

For a merit grade, all the pass grade criteria and all the merit grade criteria must be met.

For M1, learners are required to produce evidence of their practical activities performed in the laboratory. This should have been undertaken during the study of the unit content of learning outcome 1 and learning outcome 4. It would normally take the form of a written practical work in a hardback laboratory notebook.

For M2, the learners must produce a design or plan of a specialist laboratory. Written justification should be supplied to the design of individual key features. Plans can be placed on a CD ROM or on graph paper according to the abilities of the learner and their ICT skills.

For M3, the learners must identify the scientific data and records necessary for storage in an LMIS. They should justify why some information should be scientific data and why it should be only stored as records. Evidence can take the form of an essay or verbal presentation. Learners must also demonstrate an awareness of the need for security and confidentiality.

M4 requires learners to submit a discussion essay, giving details and examples to support their understanding of how safe working practices are regulated in the laboratory.

For a distinction grade, all the pass, merit and distinction grade criteria must be met.

For D1, learners should make a judgment about the importance of communicating laboratory procedures to other laboratory personnel, giving reasons and examples to support their evaluation. This could take the form of a well-structured essay.

D2 requires learners to make an informed judgment on how a well-designed laboratory fulfils its effectiveness, efficiency, safety and security purposes. Examples from industrial visits may be drawn upon to demonstrate the learners' understanding in the form of a well-constructed essay. Tutors may wish to draw up appropriate worksheets for learners to complete during these visits, to assist the implementation of this task.

D3 requires the learners to justify the necessity for keeping data and records in an LMS. Their views should be supported by evidence. The evidence can be drawn from the course content or industrial visits. Again, tutors can assist learners with the use of appropriate worksheets on any industrial visit or the visit of a guest speaker. A well-constructed essay may be necessary to achieve the criterion.

For D4, the learners must show that they understand why safe working practices are regulated in a modern laboratory. Attention should be paid to applying the most up-to-date regulations in all working practices in today's scientific environments. The learner may have to access the internet to complete this assignment. Again, industrial visits and/or guest speakers may assist greatly in the learners' understanding of this course content.

### **Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications**

This unit has links to the following units:

- *Unit 3: Scientific Investigation*
- *Unit 4: Scientific Practical Techniques*
- *Unit 9: Informatics*
- *Unit 10: Using Science in the Workplace*
- *Unit 13: Biochemical Techniques*
- *Unit 15: Microbiological Techniques*
- *Unit 20: Medical Physics Techniques*
- *Unit 21: Biomedical Science Techniques*
- *Unit 22: Chemical Laboratory Techniques.*

### Essential resources

Tutors delivering this unit will ideally have had some industrial experience as a technician or scientist. Knowledge of contemporary methods and regulations is essential in teaching this unit.

Learners should have access to the internet, a library or a learning resource centre. Visits to industrial laboratories would enable the learners to talk to technical staff in a scientific environment. This is strongly encouraged.

The use of as much technical equipment as possible pertaining to the implementation of standard laboratory practices should be sought.

Learners should have a hardback laboratory notebook to ensure all laboratory practical work is recorded.

### Indicative reading for learners

#### Textbooks

Atkinson C and Mariotte J — *The Prep Room Organiser* (Association for Science Education, 2003) ISBN 0863572839

Hutchings K — *Classic Chemistry Experiments* (The Royal Society of Chemistry, 2000) ISBN 0854049193

Morgan S — *Advanced Level Practical Work for Biology* (Hodder Murray, 2002) ISBN 0340847123



**Websites**

<a href="http://www.ase.org.uk">www.ase.org.uk</a>	The Association for Science Education
<a href="http://www.bio.org.uk">www.bio.org.uk</a>	The Institute of Biology
<a href="http://www.cdc.gov/od/ohs/safety/basicchem.htm">www.cdc.gov/od/ohs/safety/basicchem.htm</a>	Office of Health and Safety (American website: has a set of scenarios that could provoke discussion)
<a href="http://www.explorer.bio-rad.com">www.explorer.bio-rad.com</a>	Bio Rad science education
<a href="http://www.genetics.gsk.com/virtual.htm">www.genetics.gsk.com/virtual.htm</a>	GlaxoSmithKline virtual tour of genetics laboratories
<a href="http://www.hhmi.org/biointeractive/vlabs">www.hhmi.org/biointeractive/vlabs</a>	Howard Hughes Medical Institute virtual laboratory tours
<a href="http://www.infomat.net/infomat/rd_staffroom/rd1/database/cleapps">www.infomat.net/infomat/rd_staffroom/rd1/database/cleapps</a>	CLEAPSS
<a href="http://www.iop.org.uk">www.iop.org.uk</a>	The Institute of Physics
<a href="http://www.istonline.org.uk">www.istonline.org.uk</a> (go to: Publications; Laboratory Handbook; Full copy of the Handbook)	Institute of Science Technology, <i>Technician's Handbook</i> by Judson PF
<a href="http://www.mond.org">www.mond.org</a>	Society of Chemical Industry
<a href="http://www.rsc.org">www.rsc.org</a>	The Royal Society of Chemistry
<a href="http://www.scienceconsortium.co.uk">www.scienceconsortium.co.uk</a>	The Science Consortium
<a href="http://www.sciencelearningcentres.org.uk">www.sciencelearningcentres.org.uk</a>	Science Learning Centre, London
<a href="http://www.sep.org.uk">www.sep.org.uk</a>	Science Enhancement Programme
<a href="http://www.york.ac.uk/org/ciec">www.york.ac.uk/org/ciec</a>	Chemical Industry Education Centre (CIEC)