

Cambridge TECHNICALS LEVEL 3

LABORATORY SKILLS

Cambridge
TECHNICALS
2016

Unit 23

Scientific research techniques

R/615/3169

Guided learning hours: 120

V1

LEVEL 3

UNIT 23: SCIENTIFIC RESEARCH TECHNIQUES

R/615/3169

Guided learning hours: 120

Essential resources required for this unit: A functioning laboratory for purposes of carrying out titrations etc.

This unit is externally assessed by an OCR set and marked pre-release summary booklet and examination.

Unit aim

Research is fundamental to science and involves identifying key issues and questions and then designing investigations to explore them more deeply. It is through research that we decide on the key topics that require further research. It is how we improve our understanding of what is already known and where the new questions exist.

Science research begins with research questions based on scientific theories to provide improved understanding or prediction of natural or other phenomena. Applied research, in turn, uses scientific theories to develop technology or techniques to intervene and alter natural or other phenomena. Though often driven by curiosity, basic research fuels scientific innovations.

You will find out about different research approaches and methods and their strengths and limitations.

In this unit, you will be required to carry out research by using primary and secondary sources around a particular focus in the sciences.

This unit is particularly relevant if you plan to continue studying at a higher level.

TEACHING CONTENT

The unit content describes what has to be taught to ensure that learners are able to access the highest grade.

Anything which follows an i.e. details what must be taught as part of that area of content.

Anything which follows an e.g. is illustrative.

Where teaching content contains i.e. and e.g. under specific areas of content, the following rules will be adhered to when we set questions for an exam:

- A direct question may be asked about unit content which follows an i.e.
- Where unit content is shown as an e.g. a direct question will not be asked about that example.

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:		Teaching exemplification
1. Be able to develop a research plan	1.1	To analyse a brief in order to gain understanding of the task requirements. <ol style="list-style-type: none"> 1. scope of the brief covers the range of products or articles to be investigated 2. outcome that must be achieved to answer the brief 3. accuracy of outcomes that are required to answer the brief 	1.1	Learners must be given a range of industry relevant briefs to analyse. The briefs must give enough information for the learners to determine the requirements of the brief. Learners should describe what is in scope and what is out of scope for the brief in relation to the desired outcomes. Learners should be able to establish a clear desired outcome by interpreting the brief in the form of a hypothesis to be proven or disproven. Learners should clearly state the degree of accuracy to be applied to the brief. This will include accuracy of results, repeatability and sample size.

Learning Outcome The Learner will:	Teaching Content The Learner must be taught:	Teaching exemplification
	1.2 To understand the variety and sources of secondary research i.e.: <ol style="list-style-type: none"> 1. published scientific research 2. media 3. journals and books 4. scientific websites 5. trade web sites 6. scientific research institutions 7. government papers and regulations 	1.2 Learners must be given the opportunity to discuss various secondary research methods and carry out secondary research for a range of purposes. Learners will need to understand the importance of referencing of secondary research effectively. Learners will need to practice effective online search techniques and the use of appropriate academic search tools. Ideally learners will have access to academic online libraries and databases and practice the use of these.
	1.3 To develop a research plan through evaluation and selection of appropriate secondary research options to work towards the hypothesis decided on during the analysis i.e. <ol style="list-style-type: none"> 1. academic rigour 2. reliability 3. relevance 4. perspective 5. bias 	1.3 Learners should be familiar with the benefits and issues with different sources of information for secondary research. Different sources are likely to vary in academic rigour, level of detail, potential bias and reliability. Learners should be given the opportunity to discuss the different sources and compare the merits of each and then select and justify a range of secondary research options for a given purpose. Learners could be given a range of questions and asked to create a justified research plan to answer the questions. Learners could then discuss the chosen approaches.

Learning Outcome The Learner will:	Teaching Content The Learner must be taught:		Teaching exemplification
2. Be able to conduct secondary research in a given scenario to a given brief	2.1	To conduct secondary research i.e. 1. regulation 2. legislation 3. innovation 4. secondary data	2.1 Learners should use a range of secondary research techniques to establish background information and facts relating to a given subject. Learners should find conflicting and contradictory sources and form a judgement on the usefulness of the information for the given purpose.
	2.2	To record data from the secondary research i.e. 1. facts 2. opinions 3. supporting evidence 4. references 5. numerical	2.2 Learners should record data from secondary research in a format that allows the data from different sources to be compared and contrasted. Learners could be given samples of conflicting numerical data and asked to record the data in a suitable format for analysis.
	2.3	To draw conclusions based on findings i.e. 1. select key information 2. identify contradictory information 3. clearly state assumptions made 4. understand how statistical language can be used to avoid the misrepresentation of data 5. identify further data needed to make a confident conclusion	2.3 Learners could solve logic problems as an introduction to the skill of drawing conclusions. Learners could be given two news articles, written from different perspectives, and asked to draw conclusions from the content. Learners can be given statistical information based on the same data but presented in different ways. Learners can then discuss how the use of statistics can change the message on the same data. Learners must have all relevant information to be able to draw correct conclusions.

Learning Outcome The Learner will:	Teaching Content The Learner must be taught:		Teaching exemplification	
3. Be able to design a scientific investigation for a given scenario	3.1	To identify the hypothesis to be proved or disproved based on research and analysis of the brief	3.1	Learners should appreciate the use of hypotheses within scientific investigations.
	3.2	To identify required outcomes from the investigation	3.2	Learners should use the analysis of the brief and the secondary research to identify elements of the hypothesis that could be answered using scientific means.
	3.3	To create an appropriate plan for the investigation i.e.: <ol style="list-style-type: none"> 1. rationale for the choice of techniques <ol style="list-style-type: none"> a. laboratory b. field 2. Plan for the analysis i.e.: <ol style="list-style-type: none"> a. time frames b. equipment list c. risk assessment d. data recording sheets 	3.3	Learners should have been introduced to laboratory techniques in Unit 2 eg. <ul style="list-style-type: none"> • titration techniques • solvent extraction • chromatography techniques • techniques to identify cations and anions in samples Here they will be refreshing their laboratory skills in using such techniques and reviewing these and other techniques with regards to their usefulness in giving specific answers. Learners could be given a range of simple outcomes to be achieved. They could then identify and justify analytical techniques that could be used to achieve the outcomes. Learners should be able to create a written plan for the analytical investigation that clearly states the process to be followed. Learners could use the list of scenarios and create plans for the analysis.

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:		Teaching exemplification
	3.4	To evaluate and select appropriate analytical options i.e.: <ol style="list-style-type: none"> 1. data collection validity and reliability 2. consistent chemical composition 3. hazards and risks of use (e.g. toxicity, possible mutagenic agents) 4. cost 5. complexity 6. repeatability 7. reliability 8. accuracy 9. availability 	3.4	Learners should look objectively at the range of techniques available to them, that good give the required information. Learners should be able to compare the techniques using a range of aspects which allow them to select a small number for the investigation. Learners should be able to support the selection using the evaluation approach.
	3.5	To consider procedures and protocols i.e.: <ol style="list-style-type: none"> 1. Standard Analytical Practices 2. Health and Safety Procedures 3. Risk assessment <ol style="list-style-type: none"> a. written and recorded risk assessment b. adherence to risk assessment created 4. COSHH adherence <ol style="list-style-type: none"> a. material safety data sheets b. PPE c. CLEAPSS procedures 	3.5	Learners should be applying the analytical skills and approaches gained in earlier units in the context of an investigation they design. Learners could practice a broad range of analytical techniques (already studied) and review performance with regards to procedures and protocols. Learners should be able to justify their choice of procedure/protocol.
	3.6	To identify appropriate recording media i.e.: <ol style="list-style-type: none"> 1. audio 2. video 3. photographic 4. digital 	3.6	Learners should record the results of the analysis in a range of appropriate formats e.g. notebooks, tables and graphs Learners should be able to justify their choice of media. Learners should appreciate the value of sharing data via a compatible medium. Learners should appreciate the range of digital media available e.g. PowerPoint, animation, models, flow diagrams.

Learning Outcome The Learner will:	Teaching Content The Learner must be taught:		Teaching exemplification	
4. Be able to draw conclusions and make recommendations from research, analysis and feedback	4.1	Select the appropriate form of analysis i.e.: <ol style="list-style-type: none"> 1. use of mathematical techniques 2. use of graphical techniques 	4.1	Learners should have been introduced to mathematical and graphical techniques in Unit 3 and should be able to choose the appropriate technique for a given scenario. Learners should be able to analyse data collected through analytical techniques in a range of different ways. Learners could be presented with data and asked to use different approaches to analyse the data.
	4.2	To evaluate the quality of data by selecting and using the appropriate technique i.e.: <ol style="list-style-type: none"> 1. level of uncertainty 2. sources of error 3. precision 4. repeatability 5. reproducibility 	4.2	Learners should have been introduced to the concept of data quality in Unit 3 . Here they will be selecting the appropriate quality level for a given scenario. Learners should be able to justify their choice. Learners should be able to comment on the quality of the data gathered. Learners could be asked to comment on the quality of data gained from a range of analytical techniques.
	4.3	To draw justified conclusions i.e.: <ol style="list-style-type: none"> 1. comparison of primary and secondary data 2. reconciling conflicting evidence 	4.3	Learners should be able to draw conclusions based on their analysis of the data. Learners should be able to reconcile data that does not always agree and make sensible judgements in using the data. Learners could be presented with conflicting information and asked to draw justified conclusions.

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:		Teaching exemplification
	4.4	<p>The importance of feedback</p> <ol style="list-style-type: none"> 1. how to gather feedback i.e.: <ol style="list-style-type: none"> a. interviews b. conversations c. surveys d. focus groups 2. objectives of gathering feedback i.e.: <ol style="list-style-type: none"> a. clarity b. objectivity c. inspiration 3. sources of feedback i.e.: <ol style="list-style-type: none"> a. teachers b. peers c. experts 4. forms of feedback i.e.: <ol style="list-style-type: none"> a. verbal or written b. formal or informal c. structured or unstructured 5. how to evaluate feedback i.e.: <ol style="list-style-type: none"> a. analyse data b. identify patterns and trends 6. how to use feedback to improve conclusions and recommendations for further study. 	4.4	<p>Learners should be able to seek feedback on results and conclusions.</p> <p>Learners could practice giving and receiving constructive feedback with their peers.</p>

SYNOPTIC ASSESSMENT AND LINKS BETWEEN UNITS

For the assessment of this unit the knowledge and understanding required will be drawn from other mandatory units from within the Extended Diploma, in particular Units 2 and 3. This will depend on the subject of the pre-release material and the secondary research that each individual learner chooses as a result of this.

ASSESSMENT GUIDANCE

All Learning Outcomes will be assessed through an externally set, written examination paper, worth a maximum of 60 marks and 2 hours in duration. Learners will be issued with pre-release material, available from our secure website OCR Interchange, 6 weeks prior to the examination date for this unit. Learners should conduct secondary research of their choice, using the pre-release material as stimulus. Learners will be allowed to take their research notes into the examination with them however this must be in the pre-release and notes provided by OCR; research notes in any other format will not be accepted and will be treated as malpractice/maladministration. Learners are expected to submit their research notes along with their completed examination paper; failure to do so will again be treated as malpractice/maladministration.

INSTRUCTIONS FOR TEACHERS ON USE OF PRE-RELEASE MATERIAL

- Pre-release material must be issued to learners 6 weeks prior to the published examination date.
- Learners are permitted to summarise their research findings and record results/evidence/data gathered in their own research in response to the pre-release material and theme **in the notes pages at the back of this document only** (not in the margins or around the pre-release material itself).
- The notes section **must not** be used to produce a formal write-up of the research conducted.
- Teachers **must** collect in each learner's pre-release material and notes **one calendar week** prior to the exam date.
- Teachers must check that the notes made are appropriate and are the learners' own work in advance of the examination taking place.
- The pre-release and notes must then be returned to learners **immediately before the exam commences**.
- The pre-release and notes **must** be submitted along with the learners' Question Paper at the end of the examination (attached using treasury tags)

LEARNING OUTCOME (LO) WEIGHTINGS

Each learning outcome in this unit has been given a percentage weighting. This reflects the size and demand of the content you need to cover and its contribution to the overall understanding of this unit. See table below:

LO1 Be able to develop a research plan	20 - 30%
LO2 Be able to conduct secondary research in a given scenario to a given brief.	20 - 30%
LO3 Be able to design a scientific investigation for a given scenario	20 - 30%
LO4 Be able draw conclusions and make recommendations from research, analysis and feedback	20 - 30%

To find out more
ocr.org.uk/science

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