Cambridge TECHNICALS

Accredited

OCR LEVEL 2 CAMBRIDGE TECHNICAL

CERTIFICATE/DIPLOMA IN

SCIENCE

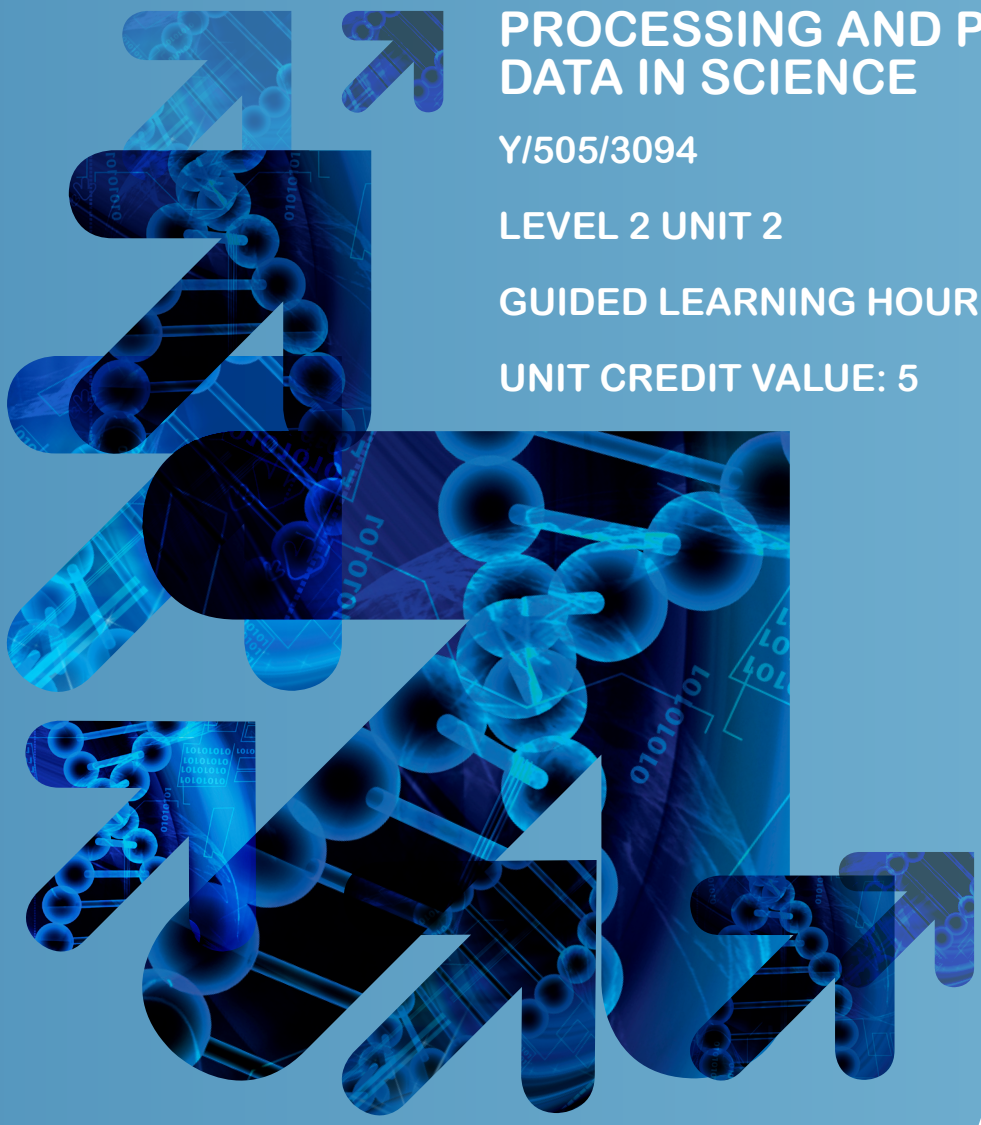
PROCESSING AND PRESENTING DATA IN SCIENCE

Y/505/3094

LEVEL 2 UNIT 2

GUIDED LEARNING HOURS: 30

UNIT CREDIT VALUE: 5



OCR

PROCESSING AND PRESENTING DATA IN SCIENCE

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AIM AND PURPOSE OF THE UNIT

Collecting and presenting high quality data is central to science. Scientific data is reported in newspapers, informs choices we make about our healthy lifestyle and diet, provides medical people with information about treatments, helps to decide how to protect our environment, informs government policy and is presented as evidence in courts of law. But how do we know if the data is 'reliable'?

This unit looks at ways of collecting a range of data using experiments. It also considers how data is presented to make it as clear and transparent as possible. Learners will review some different ways that scientific data is presented in different types of graphs, and present their own data. Throughout the unit, learners will develop the maths skills they need to handle scientific data during its collection and presentation.

ASSESSMENT AND GRADING CRITERIA

Learning Outcome (LO) The learner will:	Pass The assessment criteria are the pass requirements for this unit. The learner can:	Merit To achieve a merit the evidence must show that, in addition to the pass criteria, the learner is able to:	Distinction To achieve a distinction the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
1 Be able to collect, present and process repeatable experimental data.	P1 collect and present experimental data, including negative values, in appropriate tables with units	M1 collect and present experimental data, including negative values, in appropriate tables with units, showing consistency of decimal places and significant figures	
	P2 Process experimental data using repeats, identify outliers and calculate mean values	M2 assess the repeatability of experimental data	D1 assess the repeatability of experimental data linked to the evaluation of experimental procedures and suggest improvements where necessary
2 Know how to use scale, units, equations and graphs.	P3 discuss why different types of graphs are used in different contexts and present experimental data using simple graphs with correct units	M3 construct more complex graphs showing continuous variables in a range of contexts	D2 construct detailed graphs to show the error range and use graphs to comment on the quality of experimental data
	P4 perform calculations involving substitution into simple equations in a range of contexts	M4 perform calculations involving unit conversions, rounding and substitution in a range of contexts	D3 perform calculations involving rearrangements of simple equations, substitutions and the use of significant figures

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, it should be noted that where e.g. is used, learners must know and be able to apply relevant examples to their work though these do not need to be the same ones specified in the unit content.

LO1 Be able to collect, present and process repeatable experimental data.

- Presentation of data
  - Numbers and scale including negative numbers and numbers which include decimal places.
  - SI units.
  - The use of a range of scientific instruments to make measurements,(for example to measure amount, volume, temperature, time, mass, voltage, current, resistance, light intensity, pH).
  - Methods of presentation of data to include:
    - tables with appropriate layout, headings and units.
    - consistency of number of decimal places used to present the data from a data set.
    - use of an appropriate number of significant figures for values calculated from experimental data.
- Processing data
  - Repeats, outliers and mean values.
  - The correct use of significant figures and rounding in simple calculations.
  - Indicators of repeatability (for example comparison of repeated values, or pooled results from other groups).
  - Mathematical range between repeated values as an indicator of data quality.
  - Actions to take when repeatability is poor (for example, omitting outliers from mean value calculations, repeating experiments, altering experimental procedure).
  - The importance of sample size and range.
  - Reasons for poor repeatability (for example, variation between samples, shortcomings in techniques or equipment).
  - Evaluation of experimental apparatus, techniques or procedures to improve repeatability.

LO2 Know how to use scale, units, equations and graphs.

- Graphs
  - Line graphs with appropriate scale, labels on axes, units and titles.
  - Best fit lines or curves
  - the use of graphs to identify outliers.
  - Range bars and graphs as a means of assessing repeatability.
  - Why different graphs are useful for presenting different types of data (for example, bar charts, pie charts, line graphs).
  - The use of graphs with more than one set of data drawn on the same axis to show correlation or comparison.
- Equations
  - Substitution of values into simple equations (for example to calculate and compare Rf values, process simple titration data, calculating energy changes using $mc\Delta T$, speed calculations, $V=IR$, $F=ma$).
  - Conversion of units (for example dm^3 to cm^3).
  - Rearrangement of simple equations.

DELIVERY GUIDANCE

Learners may start the unit with some discussion or web based research to show that the repeatability of data is important because the findings of scientific investigations are used to make decisions that affect people's lives. For example by commercial companies to develop products, by the government to determine policy, by the law courts. It is important that scientists develop skills so the data they produce is repeatable. One approach may be to look at current scientific stories in the headlines and to discuss how scientists can make sure the data they present is repeatable.

This unit provides opportunities for a broad range of practical work. Learners should present and process data from their own experimental work and make comparisons with the data from other groups. The learners may work in groups to collect data, but the written evidence they produce should be individual. It is recommended that learners process some data from data loggers. If resources are limited, teachers may demonstrate the use of a data logger, and learners may present and process data produced by the teacher. The unit also lends itself to looking at some published data, for example from data published on websites. Where possible, the scenarios for the experiments may be contextualised e.g. testing acid concentration from different supermarket brands of white vinegar, investigating photosynthesis to help a pondweed manufacturer produce the plants faster, measuring resistance in different lengths of wire related to the use of long extension wires in buildings.

LO1 Be able to collect, present and process repeatable experimental data.

Learners should present data from a range of experiments. It is not necessary for the experiments to be categorised as biology, chemistry and physics, but learners should meet a range of different types of practical work with a range of different types of measurements. Simple experiments that may be used include:

- reaction times
- percentage seed germination
- photosynthesis
- bacterial growth
- simple catalysis experiments
- acid-base titrations
- chromatography
- experiments involving negative values such as the effect of salt on the freezing point of water
- dissolving salts (looking at temperature changes or solubility)
- period of a pendulum, speed, variation in electrical properties of wires
- light intensity with distance from a source
- the extension of a spring
- crater size
- the force needed to snap a thread or sample of a polymer
- time for a ball to roll down a slope or a cup cake case to fall from a height.

For merit and distinction work, it is important that the experiments chosen show variation of a continuous variable.

First attempts at collecting and presenting data could be discussed either as a group or as peer review, perhaps with the use of a tick list to check the quality of the learners' data tables. Plenary activities after each experiment may focus on how each group can justify that their data is repeatable and also on critically evaluating the experiment and suggesting improvements. More able students may adapt and repeat the experiment, and present the two sets of data for comparison.

One approach to the assignment is for each group to choose one data set they have collected, present it to the whole group, and be prepared to be challenged about how clearly presented and how repeatable their data is. The presentations could be spread throughout the guided learning hours so that one group presents each lesson. If the data from an experiment does not show repeatability, learners may discuss whether it is appropriate to calculate a mean. Learners may look at how some published data is presented as a range of values, rather than a mean (for example properties of some polymers such as HDPE and LDPE) and the reasons why this is appropriate.

LO2 Know how to use scale, units, equations and graphs.

Learners may look at websites or printed news articles that present data and select a range of different ways that the data is shown (for example tables, bar charts, pie charts, diagrams, line graphs). They could stick examples on larger sheets of paper and write around them in 'bubbles' to show why each method of data presentation is suitable for different types of data or different audiences. Learners should produce graphs of their own data, either from the experiments they did for LO1 or for different activities. Again, tick lists or peer review can be used to help learners to make sure their first attempts at drawing graphs are presented with titles, labels, units and are correctly plotted. More complex processing of graphs may be covered with more able learners, for example looking at gradients or range bars. In general, learners may find it easier to produce graphs by hand as the skills of handling superscripted units and lines of best fit of appropriate quality are difficult to produce using spreadsheets.

The calculation aspect of LO2 may be very challenging for some learners. Teachers may choose to process data using equations at the end of an experiment to avoid learners meeting a long session at the end. Ideally, some of the data used should be the learners' own data, but provided data may be used. The data should be in an experimental, rather than a theoretical context.

SUGGESTED ASSESSMENT SCENARIOS AND GUIDANCE ON ASSESSMENT

Criteria	Assignment	Scenario	Assessment
LO1	Collecting and presenting data	The learner collects and presents data from a series of experiments. The challenge is for the data to be presented as clearly as possible and for the learner to be able to 'defend' the reliability of the data that they present.	The tables of data may be presented as part of a 'log book' from the learners' experiments. P1 Tables from several experiments should be presented with clear titles, headings and appropriate units. M1 The tables presented should give opportunity to show data to at least two decimal places. The data from each experiment should be quoted to a consistent number of decimal places. Where mean values or other simple calculated values are shown in tables, the values should show appropriate rounding and use of significant figures. P2 Learners comment on reasons for repeats, calculate means and identify outliers. M2 Learners should discuss the data in their table in terms of how they can tell that the data is reliable. If the data from an activity shows a wide range, learners should discuss whether it is appropriate to calculate a mean. D1 Learners should discuss the experimental procedures and show how they do, or do not, contribute to reliable data. They should suggest modifications. If more reliable data can be gathered by simple changes to the experimental procedure, then the experiment should be adapted and repeated with the revised data also being presented and discussed.

Criteria	Assignment	Scenario	Assessment
LO2	How can data be processed to make trends and patterns in the data clear?	The learner presents the outcomes of their research using graphical and mathematical approaches.	This part of the assignment may be contextualised, for example by asking learners to present their data to be published in a newspaper or school science magazine. P3 Learners should give a short commentary on some different graph types copied from websites or newspapers. They should also draw simple graphs of their own experimental data with headings, labelled axes and units. M3 Learners should draw lines of best fit showing the change in continuous variables from several different experiments. D2 Graphs should show range bars and learners should write a commentary on how the graphs provide evidence to indicate whether or not the data is repeatable. P4 Learners should do simple calculations using either their own data or provided experimental data. They do not need to rearrange equations. M4 Learners should do simple calculations, without rearrangement involving unit conversions, rounding and appropriate use of significant figures. The calculations should use data from several different experiments. The data may be either their own or provided by the teacher. D3 The calculations involved at distinction level should demand some rearrangement before substitution.

CONTACT US

Staff at the OCR Customer Contact Centre are available to take your call between 8am and 5.30pm, Monday to Friday.
We're always delighted to answer questions and give advice.

Telephone 02476 851509
Email cambridgetechnicals@ocr.org.uk
www.ocr.org.uk