Cambridge NATIONALS

Accredited

Specification

Level 1/2 Cambridge National Certificate in Science in the Workplace (120 glh)

February 2013

OCR
Oxford Cambridge and RSA

Cambridge Nationals are vocationally related qualifications that take an engaging, practical and inspiring approach to learning and assessment.

They're industry relevant, geared to key sector requirements and very popular with schools and colleges because they suit such a broad range of learning styles and abilities.

Created to bring together the Wolf Report recommendations and industry need

The Cambridge Nationals in Science have been founded upon the recommendations of the Wolf Report and created in partnership with teachers, students, education specialists and industry-leading employers. This collaborative approach has resulted in a qualification that offers students a solid foundation for their future studies and career.

Cambridge Nationals and Cambridge Technicals – how they differ

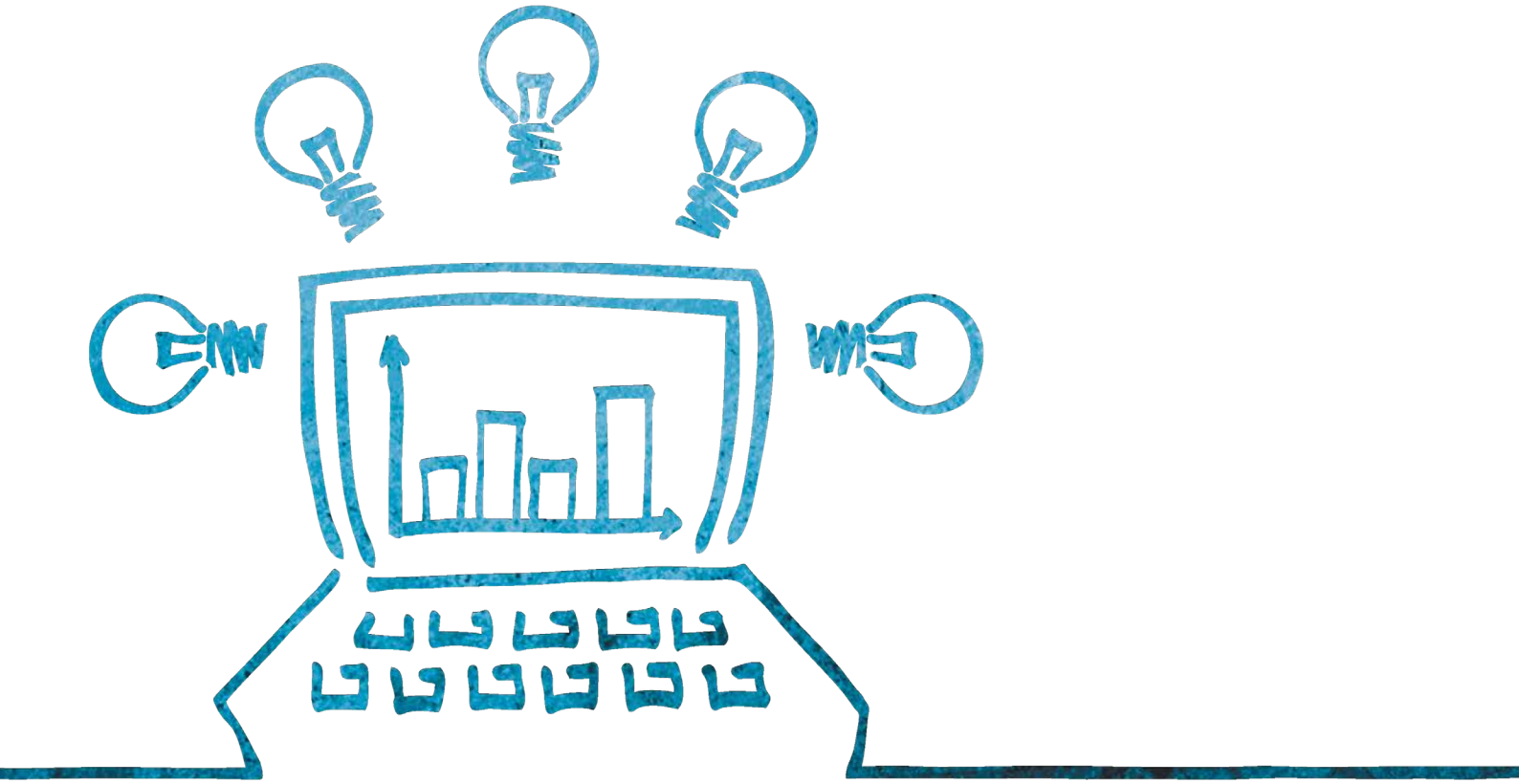
The **Cambridge National** in Science in the Workplace is targeted at 14-16 year olds in a school environment. It is available as a Certificate, which is the same size as a GCSE. It uses both internal and external assessment and is included on the DfE Performance Tables.

Cambridge Technicals are targeted at students aged 16+ in either a school or FE environment. They allow for greater flexibility with the choice of units that make up the qualification and are both internally and externally assessed. In addition, the Level 3 qualifications have UCAS points, supporting progression to HE.

A few good reasons to work with OCR

- You can enjoy the **freedom and excitement** of teaching Science qualifications that have been developed to help you inspire students of all abilities
- We've built specifications **with you in mind**, using a clear and easy-to-understand format, making them straightforward to deliver
- Our **clear and sensible assessment** approach means that assessment material and requirements are clearly presented and sensibly structured for you and your students
- **Pathways for choice** – we have the broadest range of vocational qualifications, and Cambridge Nationals provide an ideal foundation for students to progress to more advanced studies and science-related careers
- **Working in partnership to support you** – together with teachers, we've developed a range of practical help and support to save you time. We provide everything you need to teach our specifications with confidence and to ensure that your students get as much as possible from the programme of learning
- Cambridge Nationals are **supported with new innovative support products** and training – to help you get started, prepare to teach and share best practice

Sign up to teach – let us know you will be teaching this specification to ensure you receive the support you need. Simply visit **www.ocr.org.uk/cambridgenationals** for more information.



Cambridge National in Science in the Workplace

This qualification will equip students with sound, specialist scientific knowledge and skills for everyday use.

In this qualification, students explore the way in which people use science in their work. They undertake practical and investigatory activities to explore the way in which scientists use analytical techniques to collect data and how data is analysed, interpreted and evaluated. A choice of options means that the course can reflect students' interests, local business links and the environment.

Cambridge Nationals deliver these skills across the whole range of learning styles and abilities, effectively engaging and inspiring all students to achieve great things.

Overview of the qualification

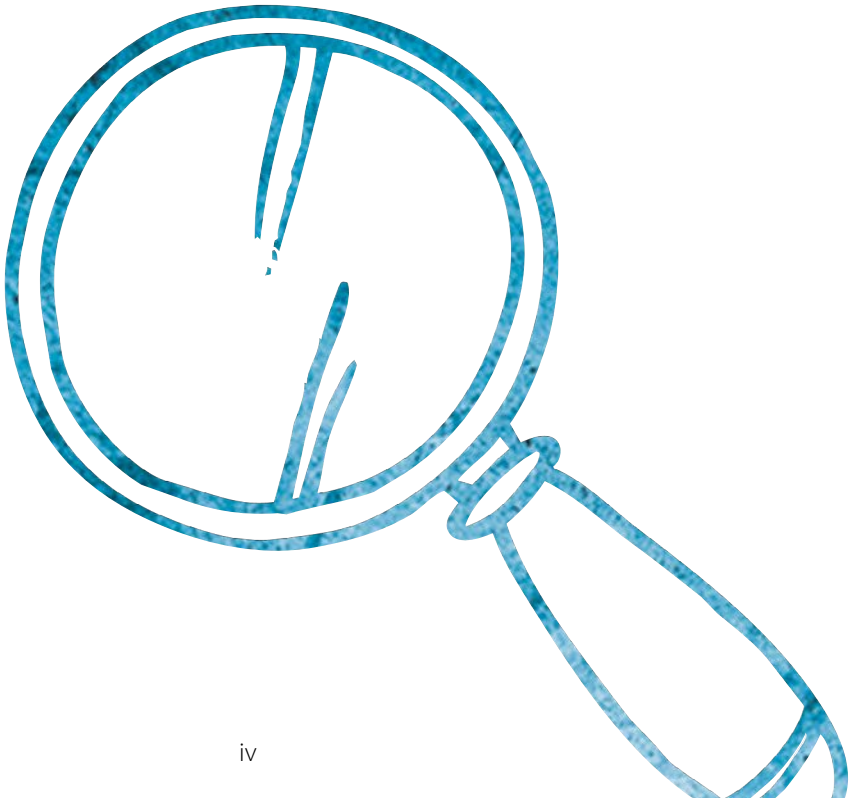
Units	Assessment Method	GLH
Mandatory		
R074: How scientists use analytical techniques to collect data	Laboratory Notebook Centre assessed tasks – OCR moderated	30
R075: How scientific data is used	Written paper, tiered, 1 hour OCR set and marked	30
Optional		
R076: Environmental science	Portfolio of work Centre assessed tasks – OCR moderated	60
R077: The science of fitness and health	Portfolio of work Centre assessed tasks – OCR moderated	60
R078: The science of production	Portfolio of work Centre assessed tasks – OCR moderated	60

Assessment and moderation

We've introduced external assessment to share the load. Unit R075 contains a written paper, which is set and assessed by ourselves, while units R076, R077 and R078 are internally assessed and externally moderated.

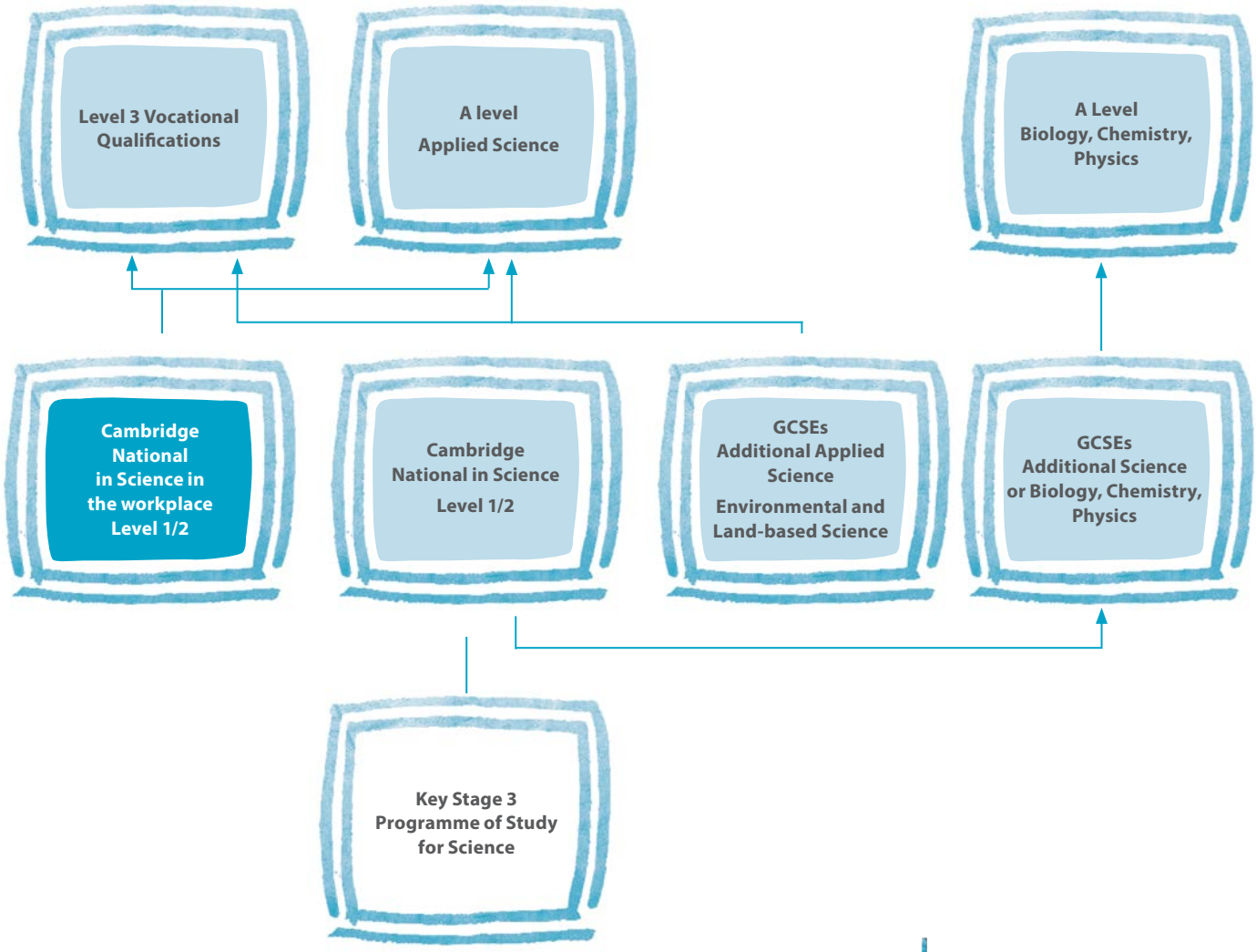
Simple and sensible certification

Units are graded Pass, Merit or Distinction for Level 1. Level 2 students have the same grades, but with a new grading of Distinction* to inspire students to achieve more.



Next steps for your students – future progression to other qualifications

The Cambridge Nationals in Science in the Workplace lead to a wide range of general and vocational qualifications for your students.



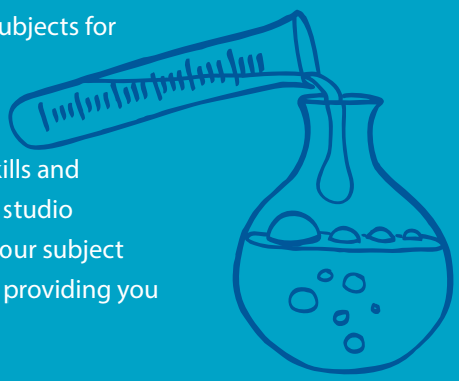
OCR Professional Development Programme

Here at OCR we are constantly looking for ways in which we can improve the support we offer to teachers. Most recently we have been considering the increasing challenges that schools face in releasing teachers for INSET, and how OCR can make its professional development programme more accessible and convenient for all by offering a number of courses online.
Thousands of users have already visited our new online training site to view and download the free material that is now available. If you haven't already, register today and take a look at the variety of support we offer.

Our new improved programme includes:

Self-managed learning – the training you want, where and when you want it

If you want to better understand the specification or keep abreast of information about previous examinations then these are for you. Available on demand 24 hours, 7 days a week with no travel or training costs, these self-contained units allow you to manage your own learning at a pace that suits you. New content is added daily, and the site currently has free material available in over 90 subjects for teachers to download, as well as several training videos and online presentations.



Live broadcasts – information and training straight to your classroom

Free broadcast events streamed live over the internet focusing on improving your delivery skills and understanding of our qualifications. These interactive sessions via single presenter webinars, studio discussions and multi-site broadcasts give you the chance to hear advice and guidance from our subject specialists and senior assessors who will be taking your questions live, or pre-submitted, and providing you with an immediate response.

Premier professional development – inspiring and advancing your teaching

Don't miss your opportunity to attend our range of face-to-face premier professional events giving you the opportunity to keep up to date with the latest developments in your subject area, visit subject related venues and obtain new and interesting approaches to teaching certain topic areas.

Providing professional development for teachers at a reduced cost for centres, this is your opportunity to gain new insights and ideas from leaders in their field and to interact with a large number of subject specialist teachers.

Face-to-face – A portfolio of more traditional INSET events

Training sessions to help you understand and get to know the new specification.

What to do next?

Check out our self-managed learning at **www.ocr.org.uk/i-want-to/professional-development/**

For further information and to book your place on our premier professional development, face-to-face and live broadcast events visit **www.ocreventbooker.org.uk**

Sign up for updates at **www.ocr.org.uk/updates** and be the first to find out about our exciting Professional Development Programme.

Need more help?

You can contact our team at **professionaldevelopment@ocr.org.uk**

Preparing for first teaching

Adopting a new specification can appear daunting. There's quite a lot of information to weigh up: the demands of the course, the quality of support, and the needs and expectations of teachers and candidates. Here's some advice to help you make the best decision.

7 Steps to First Teaching

MAKE THE MOST OF THE OCR WEBSITE

The unit specifications will be available online. While the overall programme of study might be familiar, it's important to check each unit specification to make sure that you're happy with the learning outcomes, knowledge, understanding and skills.

TAKE A TOUR OF THE SAMPLE ASSESSMENTS

They give a clear idea about the type of tasks to be undertaken. OCR will provide model assignments for centre assessed units (R074 and R076 – R078). They can be used directly or adapted to suit your needs.

MAKE GOOD MARKING DECISIONS

The specification contains information on performance indicators, which indicate the level of attainment associated with grades, marking criteria glossary of terms and guidance on assessment for you to use in addition to the marking criteria to support your marking decisions.

GET SOCIAL

Visit our social media site (**www.social.ocr.org.uk**). By registering, you'll have FREE access to a dedicated platform where teachers can engage with each other – and OCR – to share best practice, offer guidance and access a range of support materials produced by other teachers, such as lesson plans, presentations, videos and links to other helpful sites.

ENJOY SUPPORT AND GUIDANCE

It's wise to review our Report to Centres for generic guidance and explore the summary of key issues from previous assessment series. These will be available on the OCR website once the qualifications have been through their first cycle of assessment.

GET GREAT TRAINING

Check **www.ocr.org.uk/i-want-to/professional-development/** to see if there is a convenient course available. OCR's Professional Development courses are an excellent way to get practical advice on the best ways to deliver Cambridge Nationals.

EXPLORE EXTERNAL WEBSITES

It's often worthwhile carrying out an internet search to see if there is any free or paid-for resource material available. But please always check that whatever material you incorporate into your teaching meets the qualification's assessment requirements.

Administration overview

As with everything with Cambridge Nationals, we try to make your life easier. Follow these simple steps to implement the qualification in your centre.

7 steps to achievement

Get approved

If your centre is already approved for GCSEs or A Levels with OCR, your centre will be automatically approved for Cambridge Nationals.

If you don't already enter for GCSEs or A Levels with us, details on how to apply for centre approval for general qualifications can be found at: **www.ocr.org.uk/i-want-to/become-an-approved-centre/**

Make sure you sign up to teach Cambridge Nationals to ensure that you receive all the information you need to start teaching these qualifications. Sign up at: **www.ocr.org.uk/cambridgenationals**

Decide which moderation method is right for you

There are three different moderation methods to choose from:

Option A Moderation via the OCR Repository – where you upload electronic copies of the work included in the sample to the OCR Repository and your Moderator accesses the work from there.

Option B Moderation by post – where you post the sample of work to the Moderator.

Option C Moderation by visit – where the Moderator will visit you to look at the work included in the moderation sample.

Please be aware that the deadlines for marks being returned to OCR for all candidates entered for visiting moderation are much earlier than for postal or Repository methods.

Make estimated entries

To enable us to make sure that we have a Moderator for your centre, we need your Exams Officer to supply estimated entries for all Cambridge Nationals units. These are submitted through Interchange. Make sure that they use the correct entry option to identify the moderation method chosen.

Enter your candidates

Make final unit and certification entries for your candidates via Interchange or A2C. For unit entries, make sure that you use the correct entry option to identify the moderation method chosen.

If you have candidates who will have completed enough units to claim a qualification, you should make a certification entry for those candidates. Certification entries are free.

5 Submit your marks

Submit marks to OCR by the published submission date for your chosen moderation method. Marks can be returned using the paper mark sheets (MS1s) we send you, or via A2C or Interchange.

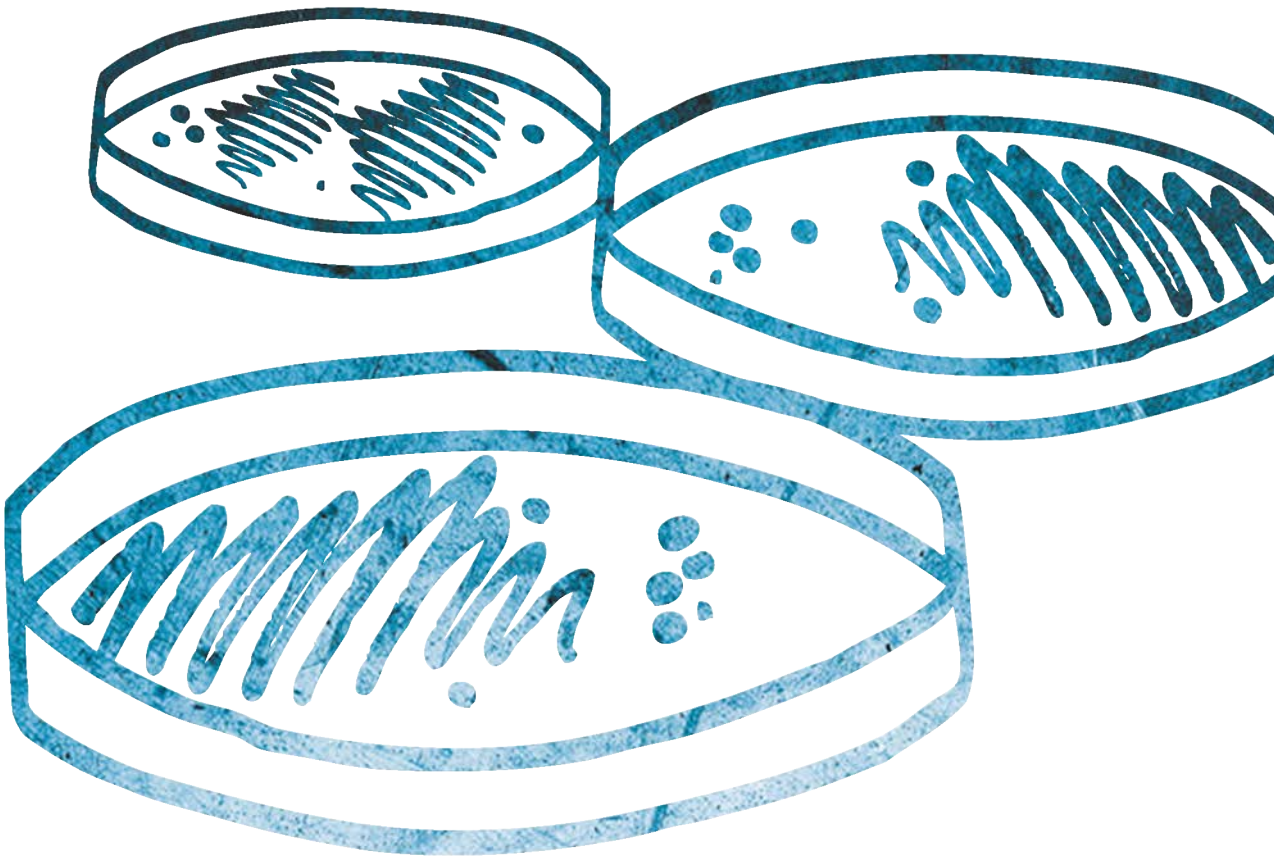
6 Prepare your moderation sample

Your Moderator will require a sample after you've submitted your marks. OCR will let you know, via email, which candidates' work will be needed. The work included in the sample should be posted to the Moderator, uploaded to the OCR Repository or prepared for the Moderator's visit, depending on the moderation method chosen.

7 Receive results

We will issue results automatically on the published day. The results are sent via A2C and are also available on Interchange. You will also receive details of any moderation adjustments applied to your marks and a report on your centre's marking from your Moderator.

Further information on the administration of Cambridge Nationals can be found in our Administration Guide **www.ocr.org.uk/admin-guides/**



Level 1/2 Cambridge National Certificate in Science in the Workplace (120 GLH) J816

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Introduction to the Cambridge National Certificate in Science in the Workplace

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1.1 Qualification aims

Science education provides learners with the skills, knowledge and understanding to participate as active and informed citizens in a modern democratic society, where science and technology play key roles in shaping our lives. As well as informing personal and social decisions throughout our lives, science education is a key pillar of the UK economy, with constant demand from employers for an increasingly skilled and technically literate workforce.

The Cambridge National Certificate in Science in the Workplace will equip learners with specialist scientific knowledge and skills for everyday use. It will challenge all learners, including high attaining learners, by introducing them to demanding material, encouraging independence and creativity, and providing tasks that develop a combination of practical, analytical and communication skills. These transferable skills will improve their learning in other subjects with the aim of enhancing their employability when they leave education, contributing to both their personal development and future economic well-being.

The practical and experiential approach that will be required for teaching and learning will engage and motivate learners and when taken with the Cambridge National Certificate in Science, the design of these qualifications, including the range of units available, will provide learners with pathways which allow the freedom to explore more deeply the areas that interest them, with opportunities to enhance their learning related to other curriculum areas and with progression routes to further qualifications in the sciences.

This Level 1/2 Certificate specification enables learners who fail to achieve the Level 2 standard to be awarded Level 1, and those learners who make progress during the course to move from work at Level 1 to achieve a qualification at Level 2.

1.2 Qualification summary

The OCR Cambridge Nationals in Science qualifications consists of:

- OCR Level 1/2 Cambridge National Certificate in **Science**
- OCR Level 1/2 Cambridge National Certificate in **Science in the Workplace**

OCR Level 1/Level 2 Cambridge National Certificate in Science

This qualification covers the National Curriculum Programme of Study for Science at Key Stage 4. It therefore meets the statutory requirement for learners in centres subject to the National Curriculum.

In teaching this course, teachers follow a scheme of work in which learners explore the way in which scientific ideas have developed, how these ideas have been applied and how these applications have affected our lives. They undertake practical and investigatory activities throughout the course to explore the way in which scientists develop and test their ideas and they develop practical skills and skills in analysing, interpreting and evaluating evidence.

OCR Level 1/2 Cambridge National Certificate in Science in the Workplace

This qualification is designed to be taken alongside or following the OCR Level 1/2 Certificate in Science or any other Level 1 or Level 2 course which covers the National Curriculum Programme of Study for Science at Key Stage 4.

In teaching this course, teachers follow a scheme of work in which learners explore the way in which people use science in their work. The qualification offers the opportunity to prepare learners for further academic or work-related study leading to other qualifications in science. The mandatory units are focussed on the transferable, underpinning knowledge and skills of analytical techniques to collect data, interpretation and evaluation methods and scientific conventions for communicating scientific ideas and data. Candidates take one of the optional units that explore how science is used in practice. The options cover science in the environment, in fitness and health and in production. The choice of optional units allows for a flexible programme of delivery so that the course can reflect learners' interests, local business links and the employment environment. Learners will undertake practical and investigatory activities throughout the course as part of exploring the way in which science is used in the workplace.

These two qualifications will replace and extend the existing OCR Science Nationals provision for which accreditation ends in 2012. They provide continuity of provision for centres currently using OCR Nationals in Science at Level 2. By providing two separate Cambridge National Certificate courses in the sciences, centres will have greater flexibility to use GCSE and Nationals courses throughout Key Stage 4, according to the needs of learners. They offer progression to further study in the sciences rather than directly into employment.

This booklet contains the specification for OCR's Cambridge National Certificate in *Science in the Workplace* for first teaching from November 2012.

1.3 Guided learning hours (GLH)

OCR Level 1/2 Cambridge National Certificate in Science in the Workplace requires 120 GLH in total.

1.4 Prior learning/attainment

Learners who are taking courses leading to this qualification should normally have completed a course covering the National Curriculum Programme of Study for Science at Key Stage 3.

1.5 Overview of the qualification

Units	Assessment method	GLH	J816 certificate 120 GLH
Mandatory			
R074: *How scientists use analytical techniques to collect data*	Laboratory Notebook Centre assessed tasks – OCR moderated Approx 10 hours – 60 marks (60 UMS)	30	Mandatory unit
R075: *How scientific data is used*	Written paper, tiered OCR set and marked 1 hour – 50 marks (60 UMS) Learners answer all questions	30	Mandatory unit
Optional			
R076: *Environmental science*	Portfolio of work Centre assessed tasks – OCR moderated Approx 20 hours – 120 marks (120 UMS)	60	Optional unit
R077: *The science of fitness and health*	Portfolio of work Centre assessed tasks – OCR moderated Approx 20 hours – 120 marks (120 UMS)	60	Optional unit
R078: *The science of production*	Portfolio of work Centre assessed tasks – OCR moderated Approx 20 hours – 120 marks (120 UMS)	60	Optional unit

A bank of model assignments is available free of charge from the OCR website for the centre assessed units R074, R076, R077 and R078.

2 Units

2.1 Guidance on unit content

Use of i.e./e.g. in unit content

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

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 in their work, though these do not need to be the same ones specified in the unit content.

Teachers will need to ensure that any modifications to tasks, from the bank of model assignments for the optional units do not expect the learner to do more than they have been taught, but they must enable them to access the full range of marks as described in the marking criteria.

For externally assessed units, where the content contains i.e. and e.g. under specific areas of content, the following rules will be adhered to when setting questions:

- direct question may be asked where the unit content is shown with an i.e.
- where unit content is shown as an e.g., a direct question will not be asked about that example. Any questions relating to the area of content will offer learners the opportunity to provide their own examples as the unit has not specified which examples they should be familiar with.

2.2 Unit R074: *How scientists use analytical techniques to collect data*

Introduction

In this unit, learners develop skills in the techniques that can be used in the collection of data and its analysis, interpretation and evaluation.

Learners will be introduced to the use of good laboratory practice, along with the principles of scientific methodology of sampling techniques, calibration of equipment and their limitations, and the importance of data. They will also develop an understanding of how the techniques used by professional scientists increase the accuracy, precision and validity of the data collected.

Contexts provided for the delivery of this unit, focus on analyses in the field of Forensic Science, but centres may 'tailor' the content within permitted parameters, e.g. to an environmental focus, geological focus, etc.

It is suggested that learners meet with and discuss elements of this unit with a range of practitioners, by visits to places of work during a period of work experience, or during visits by practitioners to the centre.

Learners produce a Laboratory Notebook incorporating assessment tasks which are internally assessed and moderated by OCR. The tasks for this unit are given an overall total of 60 marks.

The unit is weighted at 25% of the qualification and requires 30 GLH.

Aims

The focus of learning for LO1 should be on good laboratory practice. Learners will be taught that scientists select procedures that will enable them to collect valid data, i.e. procedures that will enable the scientist to measure what they truly set out to measure. Learners will need to understand that the equipment and techniques selected by scientists must also enable them to collect data of an appropriate accuracy and precision. The learner should appreciate that instruments that measure with high accuracy and precision may also need calibration before use.

Learners will develop an understanding of the importance (and legality) of working safely in the laboratory, field or scientific workplace, and should develop the skills required to construct, use and review risk assessments.

Within LO1, learners should be introduced to sampling techniques, and the idea of collecting and analysing a whole sample, representative samples or random samples. Learners will be taught how to collate and summarise the results of the analyses carried out on such samples. Learners will be taught how to assess the quality and limitations of their data, which should lead to discussions about repeatability and reproducibility, and how uncertainty can arise from random and systematic error.

The focus of learning for LO2 is on the techniques that can be used to separate and identify substances in a mixture. Learners should be taught about chromatography. They should be provided with opportunities to carry out chromatographic techniques e.g. paper or thin-layer chromatography. When carrying out these techniques learners should develop an understanding of the terms stationary phase and mobile phase in chromatography and be able to calculate R_f values. Learners should be taught that scientists use a number of alternative techniques that improve the separation of mixtures and have far greater sensitivity. These techniques should include gas chromatography (GC), High-Performance Liquid Chromatography (HPLC) and electrophoresis. Learners should be taught the principles of these techniques and their limitations.

In LO3, learners should be taught about the techniques that can be used to examine and record the features of samples, such as using visual and microscopical examination of fingerprints, fibres or hair. Learners should develop an understanding of the importance of recording observations accurately, how to take measurements, and how to calculate magnification and scale. Learners should understand the limitations of these techniques (magnification, resolution and imperfect evidence or structures hidden from view). Learners should also be taught about the use of electron microscopy, and physical techniques, such as x-rays and ultrasound analysis, as alternatives to light microscopy.

Techniques that can be used to identify cations and anions in samples are the focus in LO4. Learners should be provided with opportunities to carry out a series of flame tests and chemical tests that can be used to identify ions and analyse unknowns. Learners should develop skills that enable them to discuss the limitations of these tests. Within this LO learners should be introduced to alternative techniques that can improve the separation and identification of cations and anions in samples, for example ion chromatography, atomic emission spectroscopy (AES), and inductively coupled plasma-atomic emission spectroscopy (ICP-AES).

In LO5, learners will use acid-base titrations to determine the concentration of acids or bases/alkalis. Learners should be taught how to use equipment of an appropriate accuracy and precision, such as burettes and one-mark pipettes, to measure volumes of solutions. Learners will be taught how to choose appropriate indicators for particular titrations. They will be taught how to use calculations to determine the concentration of an acid or alkali.

The focus of learning for LO6 is the determination of the concentration of coloured substances in solution. For some learners, this will involve visual comparison with a series of standards that learners have made up. Learners will be introduced to the technique and principles of colorimetry. Learners should recognise the use of transmission and absorbance scales of the colorimeter, and be able to make decisions about the filter to use depending on the colour of the sample to be analysed. Learners should collect data and draw calibration curves using appropriate lines of best fit, then use these to determine the concentration of substances, e.g. a dye, in solution. Learners will make comparisons between the colorimetric procedure they have used, using individual filters, with the use of a single beam spectrophotometer, in which the absorbance of a sample can be measured at a specific wavelength, most often from the uv-visible range.

LO2-5 requires candidates to be introduced to alternative analytical techniques. Candidates are not expected to have a detailed understanding of how these techniques work; the focus of learning should be on the benefits of the alternative techniques, related to the quality of data these techniques can provide.

Learning Outcome (LO)	Content
LO1: Be able to apply the principles of good laboratory practice	Learners should be taught the following content: good laboratory practice i.e.: • the choice of measuring equipment and the importance of calibration • the assessment and management of risk (risk assessments; safety precautions/minimising risk) • the recording of procedures used for the collection of high quality data concepts / principles of: • the use of appropriate sampling techniques (the whole sample, representative sample, random sample) • how to assess the quality of data in terms of its repeatability and reproducibility • how to interpret evidence and suggest conclusions • how to report findings in detail and in an appropriate format • how to evaluate the quality and validity of data and procedures used and how to suggest and justify improvements.
LO2: Be able to separate and identify the substances present in a mixture	Learners should be taught the following content: techniques to separate and identify substances present in a mixture i.e.: • use chromatography to separate mixtures of coloured and colourless components • stationary and mobile phases in chromatography • calculate R_f values and make comparisons (standards, literature values) alternative techniques offering improved separation and identification, and enhanced accuracy and sensitivity e.g.: • the use of electrophoresis for the separation of the components of a mixture that are charged, i.e. in DNA analysis • the improved separation of small quantities of mixtures, and identification using standards and retention times, using gas chromatography (GC) and high performance liquid chromatography (HPLC) • quantitative analysis by calculation of areas under peaks • positive identification of the components of a mixture when a chromatograph is linked to a mass spectrometer (GC-MS and HPLC-MS).

Learning Outcome (LO)	Content
LO3: Be able to examine and record features of samples	Learners should be taught the following content: techniques to examine and record features of samples i.e.: • visual observation (including the use of a hand lens / magnifying glass) – recording the main features, making measurements of distances and lengths, and using reference samples to interpret the image • use of the light microscope, its benefits (observation of living specimens, use of incident light for surface features) and limitations • accurate recording of observations; calculating magnification and scale; use of a graticule alternative techniques offering enhanced visual examination of microscopic features and features hidden from view or difficult to access e.g.: • electron microscopy gives higher magnification and greater resolution • X-ray analysis is used to reveal 'hidden' structures, e.g. the skeleton, features of banknotes • ultrasound is used to examine structures that are difficult to access, e.g. wound depth.
LO4: Be able to identify cations and anions in samples	Learners should be taught the following content: techniques to examine and identify cations and anions in samples i.e.: • flame tests for cations: barium, Ba^{2+}; calcium, Ca^{2+}; copper, Cu^{2+}; lithium, Li^{+}; potassium, K^{+}; sodium, Na^{+} • chemical tests for cations (using precipitation reactions with sodium hydroxide): aluminium, Al^{3+}; copper, Cu^{2+}; iron(II), Fe^{2+}; iron(III), Fe^{3+}; lead, Pb^{2+} • chemical tests for anions: carbonate, CO_3^{2-} , chloride, Cl^{-}, sulfate, SO_4^{2-} alternative techniques offering improved separation, sensitivity and quantification, e.g.: • ion chromatography • atomic emission spectroscopy (AES) and inductively coupled plasma-atomic emission spectroscopy (ICP-AES).

Learning Outcome (LO)	Content

LO5: Be able to determine the concentration of an acid or base using titration	Learners should be taught the following content:
	
	techniques to determine the concentration of an acid or base using titration i.e.:
	• choice of appropriate measuring equipment (burette; one-mark pipette)
	• choice of appropriate indicators i.e.
	  ○ strong acid / strong base, i.e. bromothymol blue; any indicator
	  ○ strong acid / weak base, i.e. methyl orange
	  ○ weak acid / strong base, i.e. phenolphthalein.
	• calculation of concentration in mol/dm3 given the concentration of one solution
	
	alternative techniques offering enhanced accuracy and sensitivity e.g.:
	• pH meter
	• auto-titration.

LO6: Be able to determine the concentration of coloured substances in solution	Learners should be taught the following content: techniques to determine the concentration of coloured substances in solution i.e.: • visual comparison with standards • the use of colorimetry, using different coloured filters and by measuring absorbance (and transmission) • plot and use calibration curves alternative techniques offering enhanced accuracy and sensitivity e.g.: • the selection of suitable wavelengths to measure absorbance using a spectrophotometer.

2.3 Unit R075: *How scientific data is used*

Introduction

In this unit, learners demonstrate their knowledge and understanding of the analytical techniques used by scientists.

Learners sit a 1 hour written examination paper which is externally set and marked by OCR.

Papers are available at Level 1 and Level 2. Each paper carries 50 raw marks.

The unit is weighted at 25% of the qualification and requires 30 GLH.

Aims

The focus of learning for this unit is the way in which scientists obtain, analyse, evaluate and communicate scientific information. This unit is taught in the context of the analytical techniques experienced in unit R074, and the teaching of unit R075 may be integrated with R074.

Learners will have carried out basic analytical techniques in the classroom, but they now consider the benefits and applications of the more sophisticated techniques available in the modern workplace.

In LO1, learners consider the limitations of techniques and processes when collecting data. LO2 focuses on analytical techniques, both qualitative and quantitative, whilst LO3 looks at how data and conclusions can be evaluated. In LO4 learners are taught the relevant scientific conventions for the effective communication of scientific ideas and data.

Learners will bring to this unit skills, knowledge and understanding from Unit R074, including the use of scientific equipment to collect data and the interpretation of data to reach conclusions.

Learning Outcomes (LO)	Content
LO1: Know and understand how scientists obtain scientific information	Learners should be taught the following content, in the context of the analytical techniques included in RO74: • the identification and control of variables • the use and limitations of equipment to obtain information, i.e. paper chromatography, hand lens / magnifying glass, light microscope, flame test, titration, cation/anion tests, and colorimeters • use of more than one technique to obtain an answer • the advantages and disadvantages of alternative equipment i.e. mass spectrometer, electron microscope, spectrophotometer, pH meter • the collection of samples, i.e. avoiding contamination, labelling, storage • the calibration of equipment, i.e. colorimetry, chromatography, light microscope.
LO2: Know and understand how scientists analyse and process information	Learners should be taught the following content, in the context of the analytical techniques included in R074: • to calculate of mean, range and percentage error of data • to identify and deal with outliers and unexpected values • to identify measurement uncertainty arising from systematic and random errors • to use qualitative techniques in processing data i.e. colour, shape • to use quantitative techniques in processing data i.e. R_f values, concentration from titration, scaling of magnified images, calibration graphs.
LO3: Know and understand how scientists evaluate information	Learners should be taught the following content, in the context of the analytical techniques included in R074: • to use scientific information to make a conclusion (answer a question) • to evaluate the repeatability and reproducibility of the information • to evaluate a conclusion based on scientific information • to identify further evidence to help make a conclusion more secure • to use secondary data to support primary data for making a conclusion.
LO4: Be able to communicate scientific information	Learners should be taught the following content: how to use scientific, technical and mathematical language, conventions and symbols i.e.: • communicate abstract ideas clearly and effectively using explanations, arguments, diagrams, flow charts, pictures and tables • ensure that text is legible and that spelling, punctuation and grammar are accurate so that the meaning is clear.

Outline of Assessment

Externally set and marked examination: 60 minutes, 50 marks. All questions are compulsory.

Tiered question papers: Level 1 and Level 2, with some overlapping questions, allowing learners performing at the top of Level 1 to be given a Pass grade at Level 2.

Structured questions are used, with a balance of short and long answers, some requiring 6 mark extended answers in which quality of written communication (QWC) will be assessed (LO4). During the external assessment, learners will be expected to demonstrate their understanding through questions that require the skills of analysis (LO2) and evaluation (LO3) in particular contexts.

The remaining questions on the paper will primarily address LO1.

Weighting of LOs in the examination papers

The relative weighting of the Learning Outcomes in the written examination papers is shown in the following grid:

Learning Outgcome (LO)		%
LO1	Know and understand how scientists obtain scientific information	36
LO2	Know and understand how scientists analyse and process information	26
LO3	Know and understand how scientists evaluate information	30
LO4	Be able to communicate scientific information	8

2.4 Unit R076: *Environmental science*

Introduction

In this unit, learners will develop knowledge and understanding of how human and natural events can impact on the environment and produce environmental change. They will learn how to monitor the physical conditions of the environment both globally and locally.

Learners will be introduced to the roles of people within the environmental sector so they can see how their acquired knowledge, skills and understanding are used in the workplace. It is suggested that learners meet with and discuss the workplace roles with a range of practitioners, during a period of work experience or visits to places of work or during visits by practitioners to the centre.

Learners produce a portfolio of work incorporating assessment tasks which are internally assessed and moderated by OCR. The tasks for this unit are given an overall total of 120 marks.

The unit is weighted at 50% of the qualification and requires 60 GLH.

Aims

In LO1, learners will be taught about ecosystems. They should learn about the importance of balance within ecosystems, and that the characteristics within them are dependent upon one another. They should understand that external events, such as, natural disasters and Man's exploitation of the environment, can alter the balance of ecosystems.

Learners should develop an understanding of the cycling of nutrients in ecosystems. They should be taught how an ecosystem is affected by:

- the carbon cycle
- the nitrogen cycle
- the water cycle

Learners should understand that there is a linear flow of energy through ecosystems.

The focus of learning for LO2 should be on the consequences of human and natural events on the environment. Learners should develop an understanding of the major industrial activities that have an effect on the environment, and the advantages and disadvantages associated with these activities. Learners should be taught to appreciate that while these activities are clearly of benefit to humans, they come at a cost to the environment. Learners should also be aware of the effects of agricultural practices that were originally designed to increase food production for a growing population after the Second World War. They should also appreciate the impact of 'foreign' species, often introduced as methods of biological pest control, on natural populations e.g. the introduction of cane toads in Australia.

Learners should also be taught about the impact of natural events on the environment, such as volcanic eruptions, earthquakes and tsunamis.

In LO3, learners are introduced to how human and natural events can be monitored both at the local and global level.

At the local level, data from local councils, utility providers and observations made by the learners can be used to demonstrate how human and natural events can have an impact. Focusing on a local problem, such as maintaining a local park or the effects of a major road, can lead onto LO4 and LO5, allowing learners to monitor the local environment and ascertain the level of pollution that might be produced.

At the global level, secondary data, such as satellite images and data from weather balloons can be used to demonstrate how human and natural events can have an impact on the environment.

As part of LO4 and LO5 it is expected that learners are taught the various monitoring methods that can be used to monitor physical factors and pollution.

Building on the previous LOs, in LO6 learners should understand the need to manage the environment, at the local and global level, so that the activities we undertake for our benefit do not damage or destroy ecosystems.

It is important that learners develop an understanding of how and why industry is regulated. The focus should be on the impact on the environment and the reasons why a balance needs to be struck between our needs and that of the environment.

In LO7 and LO8, learners should have opportunities to relate their learning to the workplace. There are a wide range of environmental organisations and roles that learners might research such as: environmental health officer, environmental scientist, conservation officer, ecologist, wildlife ranger, farmer, food scientist. Learners are expected to research published material and case studies to develop an understanding of an organisation and the career roles within it.

Learning Outcomes (LO)	Content

LO1: Understand that stable ecosystems depend on balanced physical and biological environments	Learners should be taught the following content:
	
	how to define an ecosystem and an environment:
	• ecosystem – a system that includes all living organisms (biotic components) and the physical environment (abiotic components), functioning and interacting with one another
	• environment – the external surroundings (conditions, resources, stimuli etc) affecting an organism
	
	that ecosystems are made up of abiotic and biotic components that are in balance, i.e.:
	• cycling of nutrients:
	  ○ carbon cycle
	  ○ nitrogen cycle
	  ○ water cycle.

LO2: Understand the impact of human and natural events on the environment	Learners should be taught the following content: that the environment can be affected by human events, e.g. • agricultural practices • land usage • industrial and domestic emissions and waste • introduction of new species • spread of genetically-modified organisms and by natural events, e.g. • volcanic eruptions • earthquakes • floods • erosion • tsunamis

Learning Outcomes (LO)	Content
LO2: Understand the impact of human and natural events on the environment (cont.)	that these events have consequences to the environment, e.g.: • reduction in biodiversity • climate change • sea level changes • drought • flooding • human safety • community annoyance • unusable land.
LO3: Understand how physical conditions in the environment are monitored at local and global levels	Learners should be taught the following content: that a global picture of the environment can be built up using various monitoring techniques and instruments, e.g.: • satellite imaging • weather balloons • seismic sensors • marine sonar and locally by monitoring, e.g.: • levels of particulates • concentration of gases • concentration of chemicals • noise levels • amount of litter.

Learning Outcomes (LO)	Content
LO4: Be able to use standard procedures to monitor physical factors within the environment	Learners should be taught the following content: that standard measurements can be taken to monitor physical factors within the environment, e.g.: • temperature • humidity • rainfall • sunlight • ultra violet radiation • wind speed.

LO5: Be able to use standard procedures to measure the degree of pollution in the environment	Learners should be taught the following content:
	
	that the use of standard procedures can identify the degree of pollution in the environment, e.g.:
	• direct methods:
	  ○ particulates
	  ○ carbon dioxide concentration
	  ○ carbon monoxide concentration
	  ○ NO_x concentration
	  ○ nitrates
	  ○ phosphates
	
	• indirect methods:
	  ○ oxygen concentration/ Biochemical Oxygen Demand (BOD)
	  ○ pH
	  ○ microbiological counts.

Learning Outcomes (LO)	Content
LO6: Understand how the environment is managed at local and global levels	Learners should be taught the following content: ways to manage, preserve and repair the environment e.g.: • use and conservation of natural resources • the protection of habitats • the control of hazards • the control of emissions and wastes how and why industry is regulated.
LO7: Be able to describe the purpose and structure of an organisation related to the environment	Learners should be taught the following content: the purpose of the organisation, i.e.: • main purpose • key activities the structure of the organisation, i.e.: • main features • key personnel • main customer and client group served by the workplace organisation.

Learning Outcomes (LO)	Content
LO8: Be able to research career options within an environmental organisation	Learners should be taught the following content: the sources of information on career areas within the environmental sector, e.g.: • school career adviser • library • internet • employers • job centre • job advertisements • people employed in the workplace information on career areas within the environmental sector, e.g.: • range of job roles within the environmental sector • skills needed to work within the area • training requirements • types of employers • location of employers • starting packages • content of job roles • working conditions (e.g. self-employed, home-working) be able to identify information for opportunities for career areas within the environmental sector, e.g.: • progression opportunities • local, national and international opportunities • transferability to other career areas and to different types of employment (e.g. employee to self-employed) • impact of employment trends within the career area, global trends.

2.5 Unit R077: *The science of fitness and health*

Introduction

In this unit, learners will develop knowledge and understanding of the key systems in the human body. They will also develop an understanding of the consequences of health and fitness on the body.

Learners will be introduced to the health and fitness industry and careers within it. They will demonstrate how their acquired knowledge, skills and understanding are used in the workplace. It is suggested that learners meet with and discuss the workplace roles with a range of practitioners, during a period of work experience or visits to places of work or during visits by practitioners to the centre.

Learners produce a portfolio of work incorporating assessment tasks which are internally assessed and moderated by OCR. The tasks for this unit are given an overall total of 120 marks.

The unit is weighted at 50% of the qualification and requires 60 GLH.

Aims

In LO1, LO2 and LO3, learners are taught about some of the human body systems.

In LO1, the focus of learning is on the musculoskeletal system. Learners will be taught that the skeleton and muscles function together as the musculoskeletal system. They will learn that this system not only supports the body and protects body organs, but also makes the body move. They should know how the muscles and joints allow this movement and be able to measure the forces that can be produced, and the work done.

In LO2, learners will develop an understanding of the structure, function and control of the circulatory system. They will learn how blood is transported around the body in blood vessels and they should understand how the structure and function of arteries, capillaries and veins relates to this role. Learners should be provided with the opportunity to dissect a heart and to examine its structure. Learners should understand that the heart rate and pulse rate are indicators both of fitness and health.

In LO3, learners will develop an understanding of the structure, function and control of the respiratory system. Learners should be taught about the components of the respiratory system and the process of gaseous exchange; how oxygen is taken into the body, and how carbon dioxide is removed by the respiratory system. There is an opportunity for learners to investigate breathing, breathing rates and lung volumes.

In LO4, learners will focus on the consequences of health and fitness on the body. They will consider the health risks and consequences of unhealthy lifestyles. It is anticipated that learners will refer to unhealthy and unbalanced diets as well as smoking, drug taking and exercising. The use of current information on healthy lifestyles can be used to reinforce the national problems associated with the consequences of unhealthy activities. The use of learners' own experiences and case studies can be an effective link from the academic view to real life. Tutors should be aware of the sensitive nature of this area of personal health.

Following on from the previous learning outcome, LO5 introduces the learner to how health and fitness can be increased by following a fitness programme. As part of this LO learners are expected to create and develop a fitness programme for a specified group of people. Learners need to be taught that physical fitness can be divided into four components (muscular strength, speed, stamina and flexibility/suppleness), and involves the performance of the musculoskeletal system, circulatory system, and respiratory system in the body. Learners should develop an understanding that fitness will vary from person to person and how it is influenced by age, sex, heredity, personal habits, exercise and eating practices.

The focus of learning in LO6 is on measuring fitness and performance. Learners should be provided with opportunities to collect fitness data from a number of scenarios.

In LO7 and LO8, learners should have opportunities to relate their learning to the workplace. They should obtain information about the purpose and structure of an organisation related to the sports or health and fitness industry and the job roles within. Internet research will be appropriate for some organisations while for others it may be more appropriate to visit and collect leaflets, or to have representatives of an organisation visit the centre. Job roles that could be researched are varied and might include personal trainer, physiotherapist, nurse, coach, dietician, sports scientist or sports psychologist.

Learning Outcomes (LO)	Content

LO1: Understand the structure, function and control of the musculoskeletal system	Learners should be taught the following content:
	
	that the skeleton and muscles work together as the musculoskeletal system and it is this system that makes the body move.
	
	the components of the musculoskeletal system:
	• over 200 bones, e.g.
	  ○ skull
	  ○ vertebral column
	  ○ humerus
	  ○ radius and ulna
	  ○ pelvis
	  ○ femur
	  ○ tibia and fibula
	• voluntary muscles attached to bones by tendons
	• ligaments attaching bone to bone
	
	that the components have certain functions, i.e.:
	• supporting the body
	• protecting soft parts of the body
	• moving the body
	• making blood cells
	
	where two bones meet, movement is enabled by joints, i.e.:
	• hinge (elbow and knee)
	• ball and socket (shoulder and hip)
	• pivot (atlas and axis at the top of the vertebral column)
	• gliding (wrist and ankle)
	• fixed (skull)

Learning Outcomes (LO)	Content
LO1: Understand the structure, function and control of the musculoskeletal system (cont.)	the movement is made by a pair of antagonistic muscles, e.g.: • biceps and triceps muscles • these muscles provide the force which the body use to lift, pull or compress objects that the force produced by muscles can be magnified by the lever effect of the bones that they are connected to, e.g.: • first order levers (looking upwards) • second order levers (standing on tiptoe) • third order levers (lifting an object) the force produced and work done by these muscles can be measured and calculated by moving or lifting weights.
LO2: Understand the structure, function and control of the circulatory system	Learners should be taught the following content: the components of the circulatory system and their structures, i.e.: • heart • blood vessels (arteries, capillaries, veins) • blood (red blood cells, white blood cells, platelets, plasma) that the components have certain functions, i.e.: • transport (oxygen, carbon dioxide, glucose, urea, hormones) • defence • heat transfer that the performance of a person's circulatory system can be ascertained by measuring: • pulse and heart rate • blood pressure • electrocardiograms (ECGs).

Learning Outcomes (LO)	Content
LO3: Understand the structure, function and control of the respiratory system	Learners should be taught the following content: the components of the respiratory system, i.e.: • nose, mouth, and throat • trachea • bronchi • bronchioles • alveoli the adaptations that maximise gas exchange across the lungs, i.e.: • alveoli • capillaries • blood cells that the performance of a person's respiratory system can be assessed by measuring different lung volumes, e.g.: • tidal volume • vital capacity.

Learning Outcomes (LO)	Content

LO4: Understand the consequences of health and fitness factors on the body	Learners should be taught the following content:
	
	that health and fitness will depend on lifestyle, e.g.:
	• a balanced diet
	• maintaining a healthy weight by balancing energy intake (food) and energy output (physical activity)
	• taking appropriate exercise
	
	possible sources of an unhealthy lifestyle, i.e.:
	• smoking
	• drug-taking
	• over or under exercising
	• over or under eating
	• unbalanced diet
	
	that unhealthy lifestyle can lead to possible health and fitness risks, i.e.:
	• the circulatory system
	  ○ high blood pressure
	  ○ high cholesterol
	  ○ coronary heart disease (atherosclerosis, heart attack)
	  ○ stroke
	• respiratory system
	  ○ reduced lung capacity
	  ○ emphysema
	• type 2 diabetes
	• arthritis in weight bearing joints.

Learning Outcomes (LO)	Content
LO5: Be able to create a fitness programme for a specified group	Learners should be taught the following content: that fitness will depend on specific components (the four basic fitness components), i.e.: 1. muscular strength, the ability of a muscle to exert force for a brief period of time which can be increased by activities, e.g.: ○ weight training ○ running ○ push-ups 2. speed, the ability to move quickly and to react quickly which can be increased by activities, e.g.: ○ speed training ○ practise 3. stamina, the ability to keep going which can be increased by activities, e.g.: ○ long runs ○ swimming ○ walking ○ cycling ○ aerobics classes 4. flexibility/ suppleness, the ability to move joints and use muscles through their full range of motion which can be increased by activities, e.g.: ○ touching toes ○ twisting at the waist ○ stretching

Learning Outcomes (LO)	Content
LO5: Be able to create a fitness programme for a specified group (cont.)	initial assessment gives a benchmark against which to measure progress considering fitness goals how long and how hard to exercise, and what kinds of exercises to be determined by, i.e.: • age • gender • health • fitness • skill and the level of fitness that is to be achieved that a fitness programme should include: • an activity from each of the four basic fitness components • a warm-up session • cool-down session spacing out exercise sessions to: • build activity into a daily routine • allow time for recovery.

Learning Outcomes (LO)	Content
LO6: Be able to measure a person's fitness	Learners should be taught the following content: that fitness data can be collected during exercise to record performance, allow calculations of speed, rate and energy transfer, e.g.: • resting heart and pulse rates • cardiovascular endurance tests, e.g. VO_2 max and step tests, beep test • strength tests, e.g. push-ups • speed tests, e.g. running speed • flexibility tests • anthropometric tests, e.g. BMI, skinfold, bioelectrical impedance measurements and health data can be collected based on, i.e.: • blood pressure • lung function • cholesterol testing • glucose tolerance testing.
LO7: Describe the purpose and structure of an organisation related to the sports or health and fitness industry	Learners should be taught the following content: the purpose of the organisation, i.e.: • main purpose • key activities the structure of the organisation, i.e.: • main features • key personnel • main customer and client group served by the workplace organisation.

Learning Outcomes (LO)	Content
LO8: Be able to research career options within a sports or health and fitness organisation	Learners should be taught the following content: the sources of information on career areas within the sports or health and fitness sector, e.g.: • school career adviser • library • internet • employers • job centre • job advertisements • people employed in the workplace information on career areas within the sports or health and fitness sector, e.g.: • range of job roles within the career area • skills needed to work within the area • training requirements • types of employers • location of employers • starting packages • content of job roles • working conditions (e.g. self-employed, home-working) information for opportunities for career areas within the sports or health and fitness sector, e.g.: • progression opportunities • local, national and international opportunities • transferability to other career areas and to different types of employment (e.g. employee to self-employed) • impact of employment trends within the career area, global trends.

2.6 Unit R078: *The science of production*

Introduction

In this unit, learners will develop knowledge and understanding of production. The learner will have opportunities to consider production processes based on local contexts. It will allow learners to focus on a wide range of processes from agricultural, pharmaceutical, food and fuel production.

Learners will be able to evaluate the application of science and technology, recognising the need to consider:

- what society considers ethically and morally right or wrong, and
- the idea that the best decision will have the best outcome for the majority of the people involved.

Learners will have the opportunity to carry out practical activities in production processes, providing them with an introduction to the processes used in the workplace.

Learners will be introduced to the careers within the production industry, and will demonstrate how their acquired knowledge, skills and understanding are used in the workplace. It is suggested that learners meet with and discuss the workplace roles with a range of practitioners, during a period of work experience or visits to places of work or during visits by practitioners to the centre.

Learners produce a portfolio of work incorporating assessment tasks which are internally assessed and moderated by OCR. The tasks for this unit are given an overall total of 120 marks.

The unit is weighted at 50% of the qualification and requires 60 GLH.

Aims

In LO1, learners will be taught about some of the bulk chemicals important to society and their uses, e.g. fertilisers, soaps etc. Learners will need to understand that the production of bulk chemicals is on a large scale and a high degree of purity is not important (in contrast to fine chemicals). They should understand that many of the bulk chemicals that we use everyday are soluble salts, e.g. fertilisers, and that these salts are made by a neutralisation reaction between an acid and alkali.

In LO2, learners should have opportunities to produce a bulk chemical by carrying out a neutralisation reaction and measuring the yield of the product.

In LO3, learners will be taught about the factors that affect the growth of plant crops. The focus should be on how plant yields can be maximised, and how the selection of the appropriate commercial plant variety is an important factor. Learners will also be taught about the technique of genetic engineering in plants, and how it can be used to introduce desirable genes/characteristics into commercially grown plants. They should understand some of the scientific, moral and ethical objections to genetic engineering.

In LO4, learners should have the opportunity to grow a plant of commercial importance, e.g. a plant grown for food, horticultural reasons, dye plant, etc. Learners will be taught about the potential methods that can be used to monitor plant growth.

The focus of learning in LO5 should be on the types of useful products made by microorganisms. Learners will be taught that these useful products are made as a result of the waste products from microorganisms when they undergo respiration or other metabolic processes. Optimum production of the useful products from microorganisms requires the provision of appropriate conditions for the microorganisms to grow. Learners will also be taught that the waste products from microorganisms are used with or without the separation of the microorganism, and may require purification.

In LO6, learners should have the opportunity to undertake a practical investigating the optimum conditions for the production of useful products from microorganisms. This should involve learners identifying appropriate conditions for the growth of microorganisms and selecting suitable methods for determining the yield of the product.

In LO7 and LO8 learners should have opportunities to relate their learning to the workplace. They should obtain information about the purpose and structure of an organisation related to the production sector, and the job roles within. Internet research will be appropriate for some organisations while for others it may be more appropriate to visit and collect leaflets, or to have representatives of an organisation visit the centre. Job roles that could be researched are varied and might include pharmaceutical scientists, food scientists, biogenic engineers, farm managers, purveyors of food.

Learning Outcomes (LO)	Content
LO1: Understand how to produce bulk chemicals by neutralisation	Learners should be taught the following content: the importance to society of bulk inorganic chemicals, e.g. ammonia sulfate in fertiliser, sodium hydroxide in soaps and paper etc. that in the production of bulk chemicals: • production is on a large scale • a high degree of purity is not important that soluble salts can be made by reacting an acid with an alkali in a neutralisation reaction: • acid + alkali → salt + water • write a word/symbol equation for the neutralisation examples of commercially important chemicals that can be produced by neutralisation, e.g. fertilisers.
LO2: Be able to produce a bulk chemical by neutralisation and determine its yield	Learners should be taught the following content: how to carry out and monitor a neutralisation: • use a burette to measure volumes • use of a suitable indicator to determine the point of neutralisation the determination of yield: • actual yield by measuring the mass of the product • the theoretical yield of product from the relative formula masses of reactants • percentage yield • evaluate the percentage yield obtained.

Learning Outcomes (LO)	Content
LO3: Understand the factors that affect the growth of plants for commercial production	Learners should be taught the following content: factors that affect plant growth include, i.e.: • temperature • water supply • supply of mineral nutrients • light intensity • carbon dioxide concentration • pests plant growth can be maximised by changing the environmental conditions, e.g.: • increasing light intensity or carbon dioxide concentration in a greenhouse • adding fertilisers • using pesticides the importance of plant variety selection and the selection criteria that can be used, e.g.: • quality of product • yield • hardiness • resistance to disease 'improved' plant types can be produced by genetic engineering.

Learning Outcomes (LO)	Content
LO4: Be able to monitor the growth of a plant grown for commercial production	Learners should be taught the following content: the methods used to monitor plant growth, e.g.: • height • stem diameter • fresh mass • dry mass • leaf area • appearance.
LO5: Understand how products are made by microorganisms	Learners should be taught the following content: useful products are produced by microorganisms as the waste products of respiration and other metabolic processes, e.g.: • production of ethanol and carbon dioxide by anaerobic respiration of yeast (used in drinks, biofuel and in food such as bread) • production of lactic acid by lactic acid bacteria (in yoghurt; for biodegradable polymer production, pharmaceuticals) • production of antibiotics by the fermentation of certain fungi and bacteria production requires an appropriate: • food source for the microorganisms • supply of oxygen or anaerobic conditions • temperature • pH products of microorganisms can: • remain in the product, e.g. beer, bread, yogurt • be separated from the microorganisms, e.g. antibiotics, lactic acid, ethanol • require processing, e.g. Mycoprotein® (requires removal of nucleic acids).

Learning Outcomes (LO)	Content
LO6: Be able to determine the optimum conditions for production of a product by a microorganism	Learners should be taught the following content: selection of appropriate conditions for investigation: • temperature • nutrient concentration • pH suitable methods of determining the yield and the optimum conditions, e.g.: • cell numbers (yeast) • density (alcohol production) • viscosity (yogurt production) • qualitative/subjective methods, e.g. appearance, smell, texture, flavour.
LO7: Describe the purpose and structure of an organisation related to an organisation that produces products	Learners should be taught the following content: the purpose of the organisation, i.e.: • main purpose • key activities the structure of the organisation, i.e.: • main features • key personnel • main customer and client group served by the workplace organisation.

Learning Outcomes (LO)	Content
LO8: Be able to research career options within an organisation that produces products	Learners should be taught the following content: the sources of information on career areas within the production sector, e.g.: • school career adviser • library • internet • employers • job centre • job advertisements • people employed in the workplace information on career areas within the production sector, e.g.: • range of job roles within the career area • skills needed to work within the area • training requirements • types of employers • location of employers • starting packages • content of job roles • working conditions (e.g. self-employed, home-working) information for opportunities for career areas within the production sector, e.g.: • progression opportunities • local, national and international opportunities • transferability to other career areas and to different types of employment (e.g. employee to self-employed) • impact of employment trends within the career area, global trends.

Assessment of the Cambridge National Certificate in Science in the Workplace

3

3.1 Overview of the assessment in the Cambridge National Certificate in Science in the Workplace

Entry code	Qualification title	GLH	Reference
J816	**OCR Level 1/2 Cambridge National Certificate in Science in the Workplace**	**120**	**600/7042/0**

Made up of:

- Units R074 and R075
- And either R076, R077 or R078.

Individual unit details below:

Unit Details	
Unit R074: *How scientists use analytical techniques to collect data*	
30 GLH Approx 10 hours internal assessment 60 marks (60 UMS) Centre assessed and OCR moderated	The centre assessed tasks: • consists of a portfolio of work incorporating assessment tasks.
Unit R075: *How scientific data is used*	
30 GLH 1 hour written paper 50 marks (60 UMS) OCR set and marked	The question paper: • is tiered • assesses the quality of written communication.
Unit R076: *Environmental science*	
60 GLH Approx 20 hours internal assessment 120 marks (120 UMS) Centre assessed and OCR moderated	The centre assessed tasks: • consists of a portfolio of work incorporating assessment tasks.
Unit R077: *The science of fitness and health*	
60 GLH Approx 20 hours internal assessment 120 marks (120 UMS) Centre assessed and OCR moderated	The centre assessed tasks: • consist of a portfolio of work incorporating assessment tasks.
Unit R078: *The science of production*	
60 GLH Approx 20 hours internal assessment 120 marks (120 UMS) Centre assessed and OCR moderated	The centre assessed tasks: • consist of a portfolio of work incorporating assessment tasks.

3.2 Links between units and synoptic assessment

The Department for Education (DfE) has recently announced that only those qualifications that provide evidence of synoptic assessment that demonstrates pupils' broad understanding of what they have studied in their courses will be counted in the school attainment tables.

This qualification is designed with that requirement in mind. It has been written in a way that allows learners to sequentially build up their knowledge, understanding and skills between the units R074 and R075 over the course of their programme of learning, which will support them in the assessment of their units. Some of the analytical techniques covered in units R074 and R075 will also be relevant to the optional units R076, R077 and R078.

The LOs for unit R075 build on those in unit R074: in unit R074 learners have opportunities to carry out practical work, taking measurements and evaluating analytical techniques, and in unit R075, learners are taught about the scientific method and how scientists use data.

It is not necessary to complete the units in a particular order, but it is important when teaching units to be aware of the links between units so that the teaching, learning and assessment can be planned accordingly. It is, however, recommended that candidates will have covered the content (but not necessarily completed the assessment) of unit R074 before sitting the examined unit R075.

This specification booklet will support synoptic assessment by:

- showing teaching and learning links between the units across the specification
- giving guidance, with the marking criteria for the centre assessed units, about where learners could apply the knowledge and understanding from other units to improve their performance.

This qualification supports synoptic learning and assessment by employing the following principles:

- to provide content that will allow for holistic delivery and the application of prior or concurrent learning
- to enable learners to demonstrate an ability to use and apply a range of different methods and/or techniques
- to provide assessment that encourages learners to put forward different ideas and/or explanations to support decisions they have made
- to develop learners' ability to suggest or apply different approaches to contexts, situations
- to develop and assess the learners' use of transferable skills
- to enable learners to demonstrate analytical and interpretation skills (of situations and/or results) and the ability to formulate valid well-argued responses
- to enable learners to evaluate and justify their decisions, choices and recommendations.

3.3 Grading and awarding grades

3.3.1 Grade scale

All results are awarded on the following scale:

- Distinction* at Level 2 (*2)
- Distinction at Level 2 (D2)
- Merit at Level 2 (M2)
- Pass at Level 2 (P2)
- Distinction at Level 1 (D1)
- Merit at Level 1 (M1)
- Pass at Level 1 (P1).

The shortened format of the grade will be displayed on Interchange and some administrative documents provided by OCR. However the full format of the grade will appear on the certificates issued to learners.

Grades are indicated on certificates. However, results for learners who fail to achieve the minimum grade (Pass at Level 1) will be recorded as *unclassified* (U or u) and this is **not** certificated.

3.3.2 For internally assessed units, R074, R076, R077 and R078

The boundaries for Distinction at Level 2, Pass at Level 2, and Pass at Level 1 are set judgementally. Other grade boundaries are set arithmetically.

The Merit (Level 2) is set at half the distance between the Pass (Level 2) grade and the Distinction (Level 2) grade. Where the gap does not divide equally, the Merit (Level 2) boundary is set at the lower mark (e.g. 45.5 would be rounded down to 45).

The Distinction* (Level 2) grade is normally located as far above Distinction (Level 2) as Merit (Level 2) is below Distinction (Level 2).

To set the Distinction (Level 1) and Merit (Level 1) boundaries, the gap between the Pass (Level 1) grade and the Pass (Level 2) grade is divided by 3, and the boundaries set equidistantly.

Where this division leaves a remainder of 1, this extra mark will be added to the Distinction (Level 1)-Pass (Level 2) interval (i.e. the Distinction (Level 1) boundary will be lowered by 1 mark). Where this division leaves a remainder of 2, the extra marks will be added to the Distinction (Level 1)-Pass (Level 2) interval, and the Merit (Level 1)-Distinction (Level 1) interval, i.e. the Distinction (Level 1) boundary will be lowered by 1 mark, and the Merit (Level 1) boundary will be lowered by 1 mark.

For example, if Pass (Level 2) is set judgementally at 59, and Pass (Level 1) is set judgementally at 30, then Distinction (Level 1) is set at 49, and Merit (Level 1) is set at 39.

3.3.3 For the externally assessed unit, R075

The boundaries for Distinction at Level 2, Pass at Level 2, Distinction at Level 1 and Pass at Level 1 are set judgementally. Other grade boundaries are set arithmetically.

The Merit at Level 2 boundary is set at half the distance between the Pass at Level 2 boundary and the Distinction at Level 2 boundary. Where the gap does not divide equally, the Merit at Level 2 boundary is set at the lower mark (e.g. 45.5 would be rounded down to 45).

The Distinction* at Level 2 boundary is normally located as far above the Distinction at Level 2 boundary as the Merit at Level 2 boundary is below the Distinction at Level 2 boundary.

The Merit at Level 1 boundary is set at half the distance between the Pass at Level 1 boundary and the Distinction at Level 1 boundary. Where the gap does not divide equally, the Merit at Level 1 boundary is set at the lower mark (e.g. 36.5 would be rounded down to 36).

A candidate entered for Level 1 who performs markedly above the level required for the Distinction at Level 1 can achieve a Pass at Level 2.

3.3.4 Grading

This qualification is unitised. Learners can take units across several different series. They can also re-sit units. Please refer to section 7.4 *Unit and qualification re-sits* for more information. When working out learners' overall grades, OCR needs to be able to compare performance on the same unit in different series when different grade boundaries may have been set, and between different units. OCR uses a Uniform Mark Scale to enable this to be done.

A learner's uniform mark for each unit is calculated from the learner's raw mark on that unit. The raw mark boundary marks are converted to the equivalent uniform mark boundary. Marks between grade boundaries are converted on a pro rata basis.

When unit results are issued, the learner's unit grade and uniform mark are given. The uniform mark is shown out of the maximum uniform mark for the unit, e.g. 40/60.

The uniform mark boundaries for the units are shown below.

Unit GLH	Max Unit Uniform Mark	Unit Grade							
		distinction* at L2	distinction at L2	merit at L2	pass at L2	distinction at L1	merit at L1	pass at L1	u
30 L1	36	–	–	–	36	30	24	18	0
30 L2	60	54	48	42	36	–	–	–	0
30	60	54	48	42	36	30	24	18	0
60	120	108	96	84	72	60	48	36	0

The learner's uniform mark for unit R075 will be combined with the uniform mark for the centre assessed units to give a total uniform mark for the qualification. The learner's grade will be determined by the total uniform mark.

The following table shows the minimum total mark for each overall grade:

Qualification	Max Uniform Mark	Qualification Grade							
		Distinction* at L2	Distinction at L2	Merit at L2	Pass at L2	Distinction at L1	Merit at L1	Pass at L1	U
Certificate	240	216	192	168	144	120	96	72	0

3.4 Performance descriptions

The performance descriptors indicate the level of attainment associated with Distinction at Level 2, Pass at Level 2 and Pass at Level 1. They are for use at awarding meetings. They give a general indication of the levels of attainment likely to be shown by a representative learner performing at these boundaries.

Performance descriptor – Distinction at Level 2

Learners will be able to recall, select and communicate precise knowledge and detailed understanding of how and why scientists collect, analyse and evaluate data in the workplace. Learners demonstrate a clear understanding of the tentative nature of scientific knowledge, appreciate how and why this is restricted by the limitations of measuring equipment, and are able to describe in detail how scientific ideas can be validated.

In their portfolio work, learners will be able to demonstrate detailed understanding of science and its applications in a range of contexts, with a particular focus on the workplace. They will be able to work with confident independence to create material which reflects thoughtful planning, a critical analysis and interpretation of a broad range of quantitative and qualitative information and a perceptive evaluation of their findings. They will use scientific and technical knowledge, terminology and conventions appropriately and consistently. Learners will be able to independently describe the purpose and structure of organisations that utilise scientific processes, and research science based career opportunities in such organisations.

In experimental and investigative work, learners apply a comprehensive understanding of practical methods and processes and demonstrate considered judgement in the selection of appropriate scientific equipment and techniques. They apply competent mathematical, technical and observational skills, knowledge and understanding in a wide range of practical contexts. They follow procedures and methods consistently, evaluating and managing risk and working accurately and safely. Where relevant, learners reflect on the limitations of the methods and procedures they have used and the data they have collected and both propose and justify improvements. They make reasoned judgements consistent with the evidence to develop substantiated conclusions.

Performance descriptor – Pass at Level 2

Learners will be able to recall, select and communicate a secure knowledge and understanding of how and why scientists collect, analyse and evaluate data in the workplace. Learners demonstrate an understanding that scientific knowledge changes when more accurate observations and measurements can be made, and are able to describe in broad terms how scientific ideas can be validated.

In their portfolio work, learners will be able to demonstrate a secure understanding of science and its applications in a range of contexts, with a particular focus on the workplace. They will be able to work with independence to create material which reflects effective planning, analysis and interpretation of both quantitative and qualitative information and relevant evaluation of their findings. They will use scientific and technical knowledge, terminology and conventions appropriately. Learners will be able to describe the purpose and structure of organisations that utilise scientific processes, and research science based career opportunities in such organisations.

In experimental and investigative work, learners apply an understanding of practical methods and processes after practice and demonstrate adequate judgement in the selection of appropriate scientific equipment and techniques, with limited help provided. They apply secure mathematical, technical and observational skills, knowledge and understanding in some practical contexts, requiring limited guidance in others. They follow procedures and methods with limited help, make appropriate risk assessments, and work with care to achieve meaningful results. Where relevant, learners are able to comment on limitations of the methods and procedures they have used to collect data and make suggestions for improvements. They draw conclusions consistent with the available evidence.

Performance descriptor – Pass at Level 1

Learners will be able to recall, select and communicate a limited knowledge and understanding of how and why scientists collect, analyse and evaluate data in the workplace. Learners appreciate that data is needed to test scientific ideas. They demonstrate an understanding that more accurate observations can be made with more accurate equipment, and appreciate the need for other scientists to replicate measurements.

In their portfolio work, learners will be able to demonstrate a limited understanding of science and its applications in workplace contexts. They will be able to show evidence of independent work which has been planned, developed and evaluated in a simplistic way. They will use limited scientific and technical knowledge, terminology and conventions. Learners will be able to list the purpose and structure of organisations that utilise scientific processes, and with support, identify career opportunities in such organisations.

In experimental and investigative work, learners will be able to use given scientific equipment with support. They will follow procedures and methods with guidance and make relevant observations, recording results in a limited way. They will demonstrate a limited understanding of risks in procedures with standard laboratory safety. They can draw elementary conclusions having collected limited evidence.

3.5 Quality of written communication

Quality of written communication is assessed in unit R075. It is included in the mark schemes for questions requiring extended answers in the externally assessed examinations for unit R075. Recording of analytical processes, data and analyses are assessed in units R074, R076, R077 & R078.

Learners are expected to:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
- present information in a form that suits its purpose
- use a suitable structure and style of writing
- use specialist terminology, where applicable.

The centre assessed units (R074, R076, R077, R078) 4

This section provides guidance on the completion of the centre assessed units.

4.1 The centre assessed units

Each of the centre assessed units (R074, R076, R077, and R078) is designed to provide learners with the opportunity to build a portfolio of evidence to meet the learning outcomes for that unit.

We recommend that teaching and development of subject content and associated skills be referenced to real vocational situations, through the utilisation of appropriate industrial contact, vocationally experienced delivery personnel, and real life case studies.

Units R074, R076, R077 and R078 are centre assessed and externally moderated by OCR. Centres can choose whether they would like moderation via the OCR Repository, postal or visiting moderation.

Appendix B of this specification contains assessment guidance for the centre assessed units, which should be referred to in conjunction with the unit content and marking criteria grids to inform delivery of the units. The assessment guidance aims to provide clarification regarding the scope of the learning required in specific areas of the units where this is felt to be beneficial.

4.2 Resources required for the centre assessed tasks

The centre assessed tasks include both practical and research based activities.

For research tasks, learners will need access to a range of information sources relating to the scientific content and vocational contexts covered in the Learning Outcomes. This could include, but is not limited to

- libraries
- the internet
- careers advisory services
- visits to relevant local employers
- visiting speakers from local businesses
- work experience placements.

For the practical tasks, a suggested list of apparatus and materials is included in the Teacher Guidance section of each model assignment. Centres should take note of this guidance when selecting the assignments to use with their learners. Whilst there is some scope to modify practical tasks to match the availability of resources, there are mandated tasks that learners are expected to complete as part of the assessment. Learners should have had experience of these practical techniques and opportunities to develop the relevant skills before they are asked to complete the assessed task.

4.3 Tasks for the centre assessed units

A bank of model assignments is provided by OCR for units R074, R076, R077 and R078. Centres must select from the model assignments provided, to use when assessing their learners. The assignments will be available free of charge from the OCR website. Learners are able to work on the tasks anytime until the date the centre collects the work for internal assessment. OCR will review the model assignments annually which may result in an assignment being withdrawn and replaced. It is up to the centre to check the OCR website to see which model assignments are available to be used. We will give approximately 12 month's notice if a model assignment is to be withdrawn and replaced so that we do not disadvantage any learners who have already started working on an assignment that is to be replaced.

Centres can make some modifications to the model assignments that OCR provides so that the assignment can be put within a local context that learners might relate to more easily, or to allow for differences in the materials, equipment and facilities at different centres. Guidance on what can be modified is given in each assignment in the section "Information for Teachers" under *Scope of permitted model assignment modification*. If modifications are made to the model assignment, whether to just the scenario or to both the scenario and tasks, it is up to the centre to ensure that all learning outcomes can be met and that learners can assess the full range of marks.

The duration of the assessment is included in the guided learning hours for the unit. Guidance will be given within the section "Information for Teachers" in each model assignment as to approximately how long learners should expect to spend on each task.

The OCR model assignments are provided for summative assessment and not as practice materials.

Teachers must ensure learners are clear about the task they are to undertake and the criteria which they are expected to meet.

Teachers must supervise practical work, in accordance with normal practice, to ensure safety procedures (see Appendix E for further guidance).

4.3.1 Unit R074: *How scientists use analytical techniques to collect data*

Learners carry out five analytical techniques (one from each of LO2-6), making decisions about which procedures to follow, sampling techniques and presentation of data and results. Evidence for LO1, applying the principles of good laboratory practice, may be taken from any of the five practical tasks.

Learners may work individually or in groups on the task but the contribution of each learner must be clear, either in their work or by using witness statements. Each learner is expected to provide evidence in the form of a completed Laboratory Notebook. This is expected to be a working document, and not a fair copy, but all results, findings and discussions should be presented in a form that a non-scientist should be able to follow.

There are many opportunities in the task to make use of ICT, in the collection, processing and visualisation of quantitative data, but teachers and learners should be aware of the marking criteria so that learners' work can be assessed against the criteria and that marks are not limited by the media used.

There is a list of most commonly used terms in the marking criteria in Appendix C.

4.3.2 Unit R076: *Environmental science*

When the skills, knowledge and understanding identified above have been taught, learners should be given the assessment tasks to complete. Each task is relevant to one or more Learning Outcomes, so tasks may be presented to learners when they are judged to be ready to undertake them; they do not all need to be left until the end of the module.

There are four assessment tasks for this unit, one practical task, two analytical tasks, and one research task. A context is suggested for each task, but centres are free to amend the context to take advantage of local links with employers or topical issues. If the context is amended, care should be taken to ensure that the new context allows learners to access the full range of marking criteria.

Task 1 addresses LO1, LO2 and LO6, and requires learners to produce a report on the impact of human and natural events on the environment. The target audience is non scientific. The suggested context is an international conference, and can be linked through to Task 2.

Task 2 covers part of LO3 (global monitoring), and requires learners to provide briefing information for a non-scientific audience on how the environment can be monitored for change on a large scale/global level.

Task 3 addresses LO3 (local monitoring of the environment), LO4 and LO5. Learners undertake a practical task to monitor pollutants in the local environment. Learners will need to select appropriate equipment and techniques to obtain data from the local area which can then be analysed to reach conclusions. Learners may need to work in groups to undertake these tasks, but the contribution of each learner must be clear, either in their work or by using witness statements.

Learners should work individually on task 4, which addresses LO7 and LO8. Learners will describe the purpose and structure of an organisation in the environment sector and the career roles within it.

There is a list of most commonly used terms in the marking criteria in Appendix C.

4.3.3 Unit R077: *The science of fitness and health*

When the skills, knowledge and understanding identified above have been taught, learners should be given the assessment tasks to complete. Each task is relevant to one or more Learning Outcomes, so tasks may be presented to learners when they are judged to be ready to undertake them; they do not all need to be left until the end of the module.

There are three assessment tasks for this unit, one analytical task, one practical task and one research task. A context is suggested for each task, but centres are free to amend the context to take advantage of local links with employers or topical issues. If the context is amended, care should be taken to ensure that the new context allows learners to access the full range of marking criteria.

Task 1 addresses LO1, LO2, LO3 and LO4, and requires learners to produce information for a general public audience about how the structure, function and control of the musculoskeletal, circulatory and respiratory systems are affected by health and fitness. The suggested context is an advertising campaign to promote awareness of how personal health and fitness are affected by lifestyle choices.

Task 2 addresses LO5 and LO6. Learners will design a fitness programme and undertake measurements to monitor its effectiveness. Learners will need to select appropriate equipment and techniques to obtain data. The suggested context is a group of 11 to 19 year olds (this age range has been selected so learners can carry out fitness measurements in school). Learners produce an explanation of how the components of fitness affect the health of their specified group. Learners may need to work in groups to undertake these tasks, but the contribution of each learner must be clear, either in their work or by using witness statements.

Learners should work individually on task 3, which addresses LO7 and LO8. Learners will describe the purpose and structure of an organisation in the fitness and health sector and the career roles within it. The suggested context is a gym.

There is a list of most commonly used terms in the marking criteria in Appendix C.

4.3.4 Unit R078: *The science of production*

When the skills, knowledge and understanding identified above have been taught, learners should be given the assessment tasks to complete. Each task is relevant to one or more Learning Outcomes, so tasks may be presented to learners when they are judged to be ready to undertake them; they do not all need to be left until the end of the module.

There are four assessment tasks for this unit, three analytical/practical tasks and one research task.

Task 1 addresses LO1 and LO2. Learners produce a description of commercially important chemicals that can be produced by neutralisation and then carry out a neutralisation reaction and explain the theory behind the reaction. From the actual yield produced and the theoretical yield, the percentage yield can be calculated. A qualitative statement of the yield is also made. It will be expected that each learner will carry out the practical procedure as an individual.

Task 2 covers LO3 and LO4, and requires learners to produce an information leaflet on how to maximise commercial plant growth. Based on the information in the leaflet the learner should then grow a commercial plant, testing an aspect of their growth regime. It is expected that learners will grow a batch of their chosen plant taking measurements over a period of time. Learners may need to work in groups to undertake these tasks, but the contribution of each learner must be clear, either in their work or by using witness statements. Different groups could test alternative factors within the same crop, for example.

Task 3 addresses LO5 and LO6. Learners research the conditions needed for microorganisms to produce commercially useful products. Learners should then select one product, and will need to select appropriate equipment and techniques to obtain the optimum growing conditions to maximise product yield. Learners may need to work in groups to undertake these tasks, but the contribution of each learner must be clear, either in their work or by using witness statements.

Learners should work individually on task 4, which addresses LO7 and LO8. Learners will describe the purpose and structure of an organisation in the production sector and the career roles within it.

There is a list of most commonly used terms in the marking criteria in Appendix C.

4.3.5 Methods of assessment

It is the assessor's responsibility to choose the best method of assessing a learner in relation to their individual circumstances. The methods chosen must be:

- valid
- reliable
- safe and manageable and
- suitable to the needs of the learner.

Valid

Validity can be compromised if a learner does not understand what is required of them. For example, one valid method of assessing a learner's knowledge and understanding is to question them. If the questions posed are difficult for the learner to understand (not in terms of the content but the way they are phrased, for example) the validity of the assessment method is questionable.

As well as assessment methods being valid, the evidence presented must also be valid. For example, it would not be appropriate to present an organisation's equal opportunities policy as evidence towards a learner's understanding of the how the equal opportunities policy operates within the organisation. It would be more appropriate for the learner to incorporate the policy within a report, describing different approaches to equal opportunities.

Reliable

A reliable method of assessment will produce consistent results for different assessors on each assessment occasion. Internal moderators must make sure that all assessors' decisions are consistent.

Safe and manageable

Assessors and internal moderators must make sure that the assessment methods are safe and manageable and do not put unnecessary demands on the learner.

Suitable to the needs of the learner

OCR is committed to ensuring that achievement of these awards is free from unnecessary barriers. Centres must follow this commitment through when designing tasks and/or considering assessment.

4.4 Completing the tasks

Teachers/assessors are expected to supervise and guide learners when undertaking work that is internally assessed. It should be remembered, however, that the final pieces of work must be produced solely by the individual learner.

When supervising tasks, teachers/assessors are expected to:

- exercise continuing supervision of work in order to monitor progress and to prevent plagiarism
- exercise continuing supervision of practical work to ensure essential compliance with Health and Safety requirements (see Appendix E)
- ensure that the work is completed in accordance with the specification requirements and can be assessed in accordance with the specified marking criteria and procedures.

Centre assessed work should be completed in the course of normal curriculum time, and supervised and marked by the teacher/assessor. Some of the work, by its very nature, may be undertaken outside the centre, for example, research work, testing etc. As with all centre assessed work, the teacher/assessor must be satisfied that the work submitted for assessment is the learner's own.

Learners are free to revise and redraft work without teacher involvement before submitting the work for assessment. The advice provided prior to final submission should only enable the learner to take the initiative in making amendments, rather than detailing what amendments should be made. This means that teachers must not provide templates, model answers or detail specifically what amendments should be made.

Adding, amending or removing any work after it has been submitted for final assessment will constitute malpractice.

4.4.1 Presentation of the final piece of work

Learners must observe the following procedures when producing their final piece of work for the centre assessed tasks:

- work can be word processed or hand written
- tables, graphs and spreadsheets may be produced using appropriate ICT. These should be inserted into the report at the appropriate place
- any copied material must be suitably acknowledged
- quotations must be clearly marked and a reference provided wherever possible
- a completed cover sheet must be attached to work submitted for moderation. The cover sheet must include the following information as well as the marks given for each of the assessment criteria:
  - centre number
  - centre name
  - candidate number
  - candidate name
  - unit code and title
  - assignment title.

Work submitted in digital format (CD or online) for moderation or marking must be in a suitable file structure as detailed in Appendix I at the end of this specification. Work submitted on paper must be secured by treasury tags or other suitable method.

4.5 Marking and moderating centre assessed units

All centre assessed units are internally marked by centre staff using OCR marking criteria and guidance and externally moderated by the OCR-appointed moderator.

The centre is responsible for appointing someone to act as the assessor. This could be the teacher who has delivered the programme or another person from the centre.

The marking criteria must be used to mark the learners' work. These specify the levels of skills, knowledge and understanding that the learner is required to demonstrate.

The following assessment methods are considered suitable for teachers/assessors to adopt for these qualifications alongside the assessment of the evidence submitted by the learner:

- **observation** of a learner performing a task
- **questioning** of the learner or witness.

Observation

The teacher/assessor and learner should plan observations together but it is the teacher's/assessor's responsibility to record the observation properly.

Questioning

Questioning the learner is normally an ongoing part of the assessment process, and may in some circumstances provide evidence to support achievement of learning outcomes.

Questioning is often used to:

- test a learner's understanding of work which has been completed outside of the classroom
- check if a learner understands the work they have undertaken
- collect information on the type and purpose of the processes a learner has gone through.

If questioning is to be used as evidence towards achievement of specific learning outcomes, it is important that teachers/assessors record enough information about what they asked and how the learner replied, to allow the assessment decision to be moderated.

Questioning witnesses is normally an ongoing part of validating written witness statements. However, questioning witnesses can be used for other purposes. Teachers/assessors should be able to speak to witnesses and record, in whatever way is suitable, the verbal statements of these witnesses. A record of a verbal statement is a form of witness statement and could provide valuable evidence. Further guidance on the use of witness statements can be found in Appendix A.

4.5.1 Use of a 'best fit' approach to marking criteria

The assessment tasks should be marked by teachers/assessors according to the OCR marking criteria using a 'best fit' approach. For each of the marking criteria, teachers/assessors select the band descriptor provided in the marking grid that most closely describes the quality of the work being marked.

Marking should be positive, rewarding achievement rather than penalising failure or omissions.

The award of marks **must be** directly related to the marking criteria.

- Each band descriptor covers all the relevant content for the learning outcomes.
- The descriptors should be read and applied as a whole.
- Make a best fit match between the answer and the band descriptors.
- An answer does not have to meet all of the requirements of a band descriptor before being placed in that band. It will be placed in a particular band when it meets more of the requirements of that band than it meets the requirements of other bands.
- Where there is more than one strand within the band descriptors for a learning outcome and a strand has not been addressed at all, it is still possible for the answer to be credited within that mark band depending upon the evidence provided for the remaining strands. The answer should be placed in the mark band most closely reflecting the standard achieved across all strands within the band descriptors for a learning outcome; however in this scenario, the mark awarded for that band should reflect that a strand has not been addressed.

When deciding the mark within a band, the following criteria should be applied:

- the extent to which the statements within the band have been achieved.

For example:

- an answer that convincingly meets nearly all of the requirements of a band descriptor should be placed at or near the top of that band. Where the learner's work *convincingly* meets the statements, the highest mark should be awarded
- an answer that meets many of the requirements of the band descriptor should be placed in the middle of the band. Where the learner's work *adequately* meets the statements, the most appropriate mark in the middle range should be awarded
- if an answer is on the border-line between two bands but it is decided that it better fits the descriptors for the lower of these two bands, then it should be placed near the top of that lower band. Where the learner's work *just* meets the statements for the higher band, the lowest mark for that higher band should be awarded.

Teachers/assessors should use the full range of marks available to them and award full marks in any band for work that fully meets that descriptor. This is work that is 'the best one could expect from learners working at that level'.

4.5.2 Annotation of learners' work

Each piece of internally assessed work should show how the marks have been awarded in relation to the marking criteria.

The writing of comments on learners' work, and cover sheet, provides a means of communication between teachers during the internal standardisation and with the moderator if the work forms part of the moderation sample.

4.6 Authentication

Teachers/assessors must be confident that the work they mark is the learner's own. This does not mean that a learner must be supervised throughout the completion of all work, but the teacher must exercise sufficient supervision, or introduce sufficient checks, to be in a position to judge the authenticity of the learner's work.

Wherever possible, the teacher should discuss work-in-progress with learners. This will not only ensure that work is underway in a planned and timely manner, but will also provide opportunities for teachers/assessors to check authenticity of the work.

Learners must not plagiarise. Plagiarism is the submission of another's work as one's own and/or failure to acknowledge the source correctly. Plagiarism is considered to be malpractice and could lead to the learner being disqualified. Plagiarism sometimes occurs innocently when learners are unaware of the need to reference or acknowledge their sources. It is therefore important that centres ensure that learners understand that the work they submit must be their own and that they understand the meaning of plagiarism and what penalties may be applied. Learners may refer to research, quotations or evidence but they must list their sources. The rewards from acknowledging sources, and the credibility they will gain from doing so, should be emphasised to learners as well as the potential risks of failing to acknowledge such material.

Both learners and teachers must declare that the work is the learner's own:

- **Each learner** must sign a declaration before submitting their work to their teacher. A learner authentication statement that can be used is available to download from the OCR website. These statements should be retained within the centre until all enquiries about results, malpractice and appeals issues have been resolved. **A mark of zero must be recorded if a learner cannot confirm the authenticity of their work.**
- Centres must confirm to OCR that the evidence produced by learners is authentic. **Teachers** are required to declare that the work submitted for centre assessment is the learner's own work by completing a Centre Authentication Form for each unit. If a centre fails to provide evidence of authentication, **we will set the mark for the learner(s) concerned to Pending (Q) for that unit until authentication can be provided**. The Centre Authentication Form is available to download from the OCR website and includes a declaration which teachers must sign.

4.6.1 Internal standardisation

It is important that all teachers/assessors work to common standards. Centres must ensure that, within each unit, the internal standardisation of marks across teachers/assessors and teaching groups takes place using an appropriate procedure.

This can be done in a number of ways. In the first year, reference material and OCR training meetings will provide a basis for centres' own standardisation. In subsequent years, this, or centres' own archive material, may be used. Centres are advised to hold preliminary meetings of staff involved to compare standards through cross-marking a small sample of work. After most marking has been completed, a further meeting at which work is exchanged and discussed will enable final adjustments to be made.

4.6.2 Submitting marks

All work for centre assessment is marked by the teacher/assessor and internally standardised by the centre. Marks are then submitted to OCR; see Section 4.6 for submission dates of the marks to OCR.

There should be clear evidence that work has been attempted and some work produced. If a learner submits no work for a centre assessed unit, then the learner should be indicated as being absent from that unit. If a learner completes any work at all for a centre assessed unit, then the work should be assessed according to the marking criteria and the appropriate mark awarded, which may be zero.

4.7 Moderation

The purpose of external moderation is to ensure that the standard of marking is the same for each centre and to ensure that internal standardisation has taken place.

Centres can select from:

- **Moderated via OCR Repository (see section 4.7.1)**
- **Moderated via postal moderation (see section 4.7.2)**
- **Moderated via visiting moderation (see section 4.7.3)**

The deadline dates for entries and submission of marks for each moderation method are detailed below. Centres must ensure when selecting a moderation method that the appropriate entry and marks submission deadlines can be adhered to.

Moderation method	January series		June series		November series (2013 onwards)	
	Entries	Marks	Entries	Marks	Entries	Marks
Moderated via OCR Repository	21st Oct	10th Jan	21st Feb	15th May	4th Oct	4th Oct
Moderated via postal moderation	21st Oct	10th Jan	21st Feb	15th May	5th Nov	5th Nov
Moderated via visiting moderation	21st Oct	10th Dec	21st Feb	31st Mar	Not available	

When making your entries, the entry option specifies how the work is going to be moderated.

For each unit, you must choose the same moderation method for **all** learners (i.e. all learners for that unit in that series must be entered using the same entry option). However, you can choose different moderation methods for different units and in different series.

Sample requests

Once you have submitted your marks, your exams officer will receive an email telling you which work will be sampled as part of the moderation. Samples will include work from across the range of attainment of the learners' work.

Each learner's work must have a cover sheet attached to it with a summary of the marks awarded for the task. If the work is to be submitted via OCR Repository this cover sheet must also be submitted electronically within each learner's files.

OCR will require centres to release work for awarding and archive purposes and the co-operation of the centre is most appreciated in these instances, as it is imperative to have work available at awarding meetings. If this is required then centres will be notified as early as possible.

Centres will receive the final outcome of moderation when the provisional results are issued. The following reports will be issued via Interchange:

- Moderation adjustments report – This lists any scaling that has been applied to internally assessed units
- Moderator report to centres – This is a brief report by the moderator on the internal assessment of learners' work.

4.7.1 Moderated via OCR Repository

The OCR Repository is a secure website for centres to upload candidate work and for assessors to access this work digitally. Centres can use the OCR Repository for uploading marked candidate work for moderation.

Centres can access the OCR Repository via OCR Interchange, find their candidate entries in their area of the Repository, and use the Repository to upload files (singly or in bulk) for access by their moderator.

The OCR Repository allows candidates to produce evidence and files that would normally be difficult for postal submissions, for example multimedia and other interactive unit submissions.

The OCR Repository is seen as a faster, greener and more convenient means of providing work for assessment. It is part of a wider programme bringing digital technology to the assessment process, the aim of which is to provide simpler and easier administration for centres.

All moderated units can be submitted electronically to the OCR Repository via Interchange: please check section 7.2.2 for unit entry codes for the OCR Repository.

There are three ways to load files to the OCR Repository:

1. Centres can load multiple files against multiple candidates by clicking on 'Upload candidate files' in the Candidates tab of the Candidate Overview screen.
2. Centres can load multiple files against a specific candidate by clicking on 'Upload files' in the Candidate Details screen.
3. Centres can load multiple administration files by clicking on 'Upload admin files' in the Administration tab of the Candidate Overview screen.

Instructions for how to upload files to OCR using the OCR Repository can be found on OCR Interchange.

4.7.2 Moderated via postal moderation

Your sample of work must be posted to the moderator within three days of receiving the request. You should use one of the labels provided by OCR to send the learner's work.

We would advise you to keep evidence of work submitted to the moderator, e.g. copies of written work or photographs of practical work. You should also obtain a certificate of posting for all work that is posted to the moderator.

Work may be submitted in digital format (on CD) for moderation but must be in a suitable file structure as detailed in Appendix I at the end of this specification.

4.7.3 Moderated via visiting moderation

Your sample of work must be retained in the centre ready for the moderation visit.

The work that is presented to the visiting moderator as their initial sample must be available in rank order, by unit, to allow moderation to take place. All work not selected for initial sampling **must** be available to the visiting moderator during their visit should they need to extend their sample.

At the end of the visit, the moderator may need to take samples of work away or request for work to be posted to them for further consideration.

All learners' work must be retained securely within the centre until results are issued and it is certain that no enquiries about results or appeal procedure is required.

5 Support for the Cambridge National Certificate in Science in the Workplace

5.1 Free resources available from the OCR website

The following materials will be available on the OCR website:

- specification
- specimen assessment materials for unit R075
- a choice of 3 model assignments for unit R074
- a flexible model assignment for each of units R076, R077 and R078.

5.2 Other resources

OCR has produced a range of resources, all available free of charge from the OCR website.

Endorsed publications

OCR endorses a range of publisher materials to provide quality resources for centres delivering its qualifications. You can be confident that materials branded with OCR's 'Official Publisher Partnership' or 'Approved publication' logos have undergone a thorough quality assurance process to achieve endorsement. All responsibility for the content of the publisher's materials rests with the publisher.

These endorsements would not mean that such materials would be the only suitable resources available or necessary to achieve an OCR qualification.

5.3 Training

OCR will offer a range of support activities for all practitioners throughout the lifetime of the qualification to ensure they have the relevant knowledge and skills to deliver the qualification. The launch of the qualification will be supported by face to face training, with additional training to follow on the internally assessed units. Online training, consisting of interactive and non-interactive elements providing up to date feedback and guidance, will also be available.

Please see Event Booker for further information.

5.4 OCR support services

5.4.1 Active Results

Active Results is available to all centres offering the Cambridge Nationals qualifications.

Active Results is a free results analysis service to help teachers review the performance of individual learners or whole schools.

Devised specifically for the UK market, data can be analysed using filters on several categories such as gender and other demographic information, as well as providing breakdowns of results by question and topic.

Active Results allows you to look in greater detail at your results:

- richer and more granular data will be made available to centres including question level data available from e-marking for unit R075
- you can identify the strengths and weaknesses of individual learners and your centre's cohort as a whole
- our systems have been developed in close consultation with teachers so that the technology delivers what you need.

Further information on Active Results can be found on the OCR website.

5.4.2 OCR Interchange

OCR Interchange has been developed to help you to carry out day-to-day administration functions online, quickly and easily. The site allows you to register and enter learners online. In addition, you can gain immediate and free access to learner information at your convenience. Sign up at https://interchange.ocr.org.uk.

6 Access to the Cambridge National Certificate in Science in the Workplace

6.1 Equality Act information relating to Cambridge Nationals in Science

Cambridge Nationals in Science often require assessment of a broad range of competences and, as such, prepare learners for a wide range of occupations and higher level courses.

The Cambridge Nationals in Science qualifications were reviewed to identify whether any of the competences required by the subject presented a potential barrier to any disabled learners. If this was the case, the situation was reviewed again to ensure that such competences were included only where essential to the subject.

Reasonable adjustments are made for disabled learners in order to enable them to access the assessments and to demonstrate what they know and can do. For this reason, very few learners will have a complete barrier to the assessment. Information on reasonable adjustments is found in *Access Arrangements, Reasonable Adjustments and Special Consideration* produced by the Joint Council for Qualifications www.jcq.org.uk.

The access arrangements permissible for use in this specification are as follows:

Access Arrangement	Yes/No	Type of Assessment
Readers	Yes	All assessments
Scribers	Yes	All assessments
Practical assistants	Yes	All assessments
Word processors	Yes	All assessments
Transcripts	Yes	All assessments
BSL interpreters	Yes	All assessments
Oral language modifiers	Yes	All assessments
Modified question papers	Yes	All assessments
Extra time	Yes	All assessments

6.2 Arrangements for learners with particular requirements

All learners with a demonstrable need may be eligible for access arrangements to enable them to show what they know and can do. The criteria for eligibility for access arrangements can be found in the JCQ document *Access Arrangements, Reasonable Adjustments and Special Consideration*.

If a successful application for an access arrangement has been made for either GCSE or GCE, then there is no need to make an additional application for the same learner completing a Cambridge National qualification.

Learners who have been fully prepared for the assessment but who have been affected by adverse circumstances beyond their control at the time of the examination, may be eligible for special consideration. Centres should consult the JCQ document *Access Arrangements, Reasonable Adjustments and Special Consideration*.

Administration of the Cambridge National Certificate in Science in the Workplace

7

Full details of the administrative arrangements can be found in the Cambridge Nationals Admin Guide. The Admin Guide is available from the OCR website.

7.1 Availability of assessment

There are three assessment series each year in January, June and November. All units will be assessed from June 2013. Assessment availability can be summarised as follows:

	Unit R075	Unit R074 and R076–R078
June 2013	✓	✓
November 2013	–	✓*
January 2014	✓	✓
June 2014	✓	✓
November 2014	–	✓*

Certification is available for the first time in June 2013 and each January, June and November thereafter.

* Visiting moderation is not available in the November series. Please see section 4.7 for details on the moderation methods available in each series.

7.2 Making entries

Centres must be registered with OCR in order to make any entries, including estimated entries. It is recommended that centres apply to OCR to become a registered centre well in advance of making their first entries. Details on how to register with OCR can be found on the OCR website.

Centres must have made an entry for a unit in order for OCR to supply the appropriate forms and allocate a moderator for centre assessment.

It is essential that unit entry codes are quoted in all correspondence with OCR.

7.2.1 Making estimated unit entries

Estimated entries must be made prior to each assessment series. Estimated entries are used by OCR to allocate examiners and moderators to centres.

7.2.2 Making final unit entries

When making an entry centres must quote unit entry code and component codes. For the centre assessed units, centres must decide whether they want to submit learners' work for moderation via the OCR Repository or for postal or visiting. Learners submitting work must be entered for the appropriate unit entry code from the table below.

Unit entry code	Component code	Assessment method	Unit titles
R074 A	01	Moderated via OCR Repository	*How scientists use analytical techniques to collect data*
R074 B	02	Moderated via postal moderation	
R074 C	03	Moderated via visiting moderation	
R075 A	01	Written paper – Level 1	*How scientific data is used*
R075 B	02	Written paper – Level 2	
R076 A	01	Moderated via OCR Repository	*Environmental science*
R076 B	02	Moderated via postal moderation	
R076 C	03	Moderated via visiting moderation	
R077 A	01	Moderated via OCR Repository	*The science of fitness and health*
R077 B	02	Moderated via postal moderation	
R077 C	03	Moderated via visiting moderation	
R078 A	01	Moderated via OCR Repository	*The science of production*
R078 B	02	Moderated via postal moderation	
R078 C	03	Moderated via visiting moderation	

The short title for these Cambridge National qualifications is CAMNAT and will display as such on Interchange and some administrative documents provided by OCR.

7.3 Certification rules

Learners must be entered for qualification certification separately from unit assessment(s). If a certification entry is **not** made, no overall grade can be awarded.

Learners may be entered for:

- OCR Level 1/2 Cambridge National Certificate - certification code J816

There are no terminal requirements for this qualification therefore learners can complete units in any order.

7.4 Unit and qualification re-sits

Learners may re-sit each unit an unlimited number of times. The best result will be used to calculate the certification result.

Learners may enter for the qualification an unlimited number of times. Learners must retake at least one unit, or take a different optional unit, for a new result to be issued.

7.5 Enquiries about results

Under certain circumstances, a centre may wish to query the result issued to one or more learners. Enquiries about Results for all units must be made immediately following the series in which the relevant unit was taken (by the Enquiries about Results deadline).

Please refer to the JCQ Post-Results Services booklet and the OCR Admin Guide for further guidance about action on the release of results. Copies of the latest versions of these documents can be obtained from the OCR website.

For internally assessed units the enquiries about results process cannot be carried out for one individual learner; the outcome of a review of moderation must apply to a centre's entire cohort.

7.6 Shelf-life of units

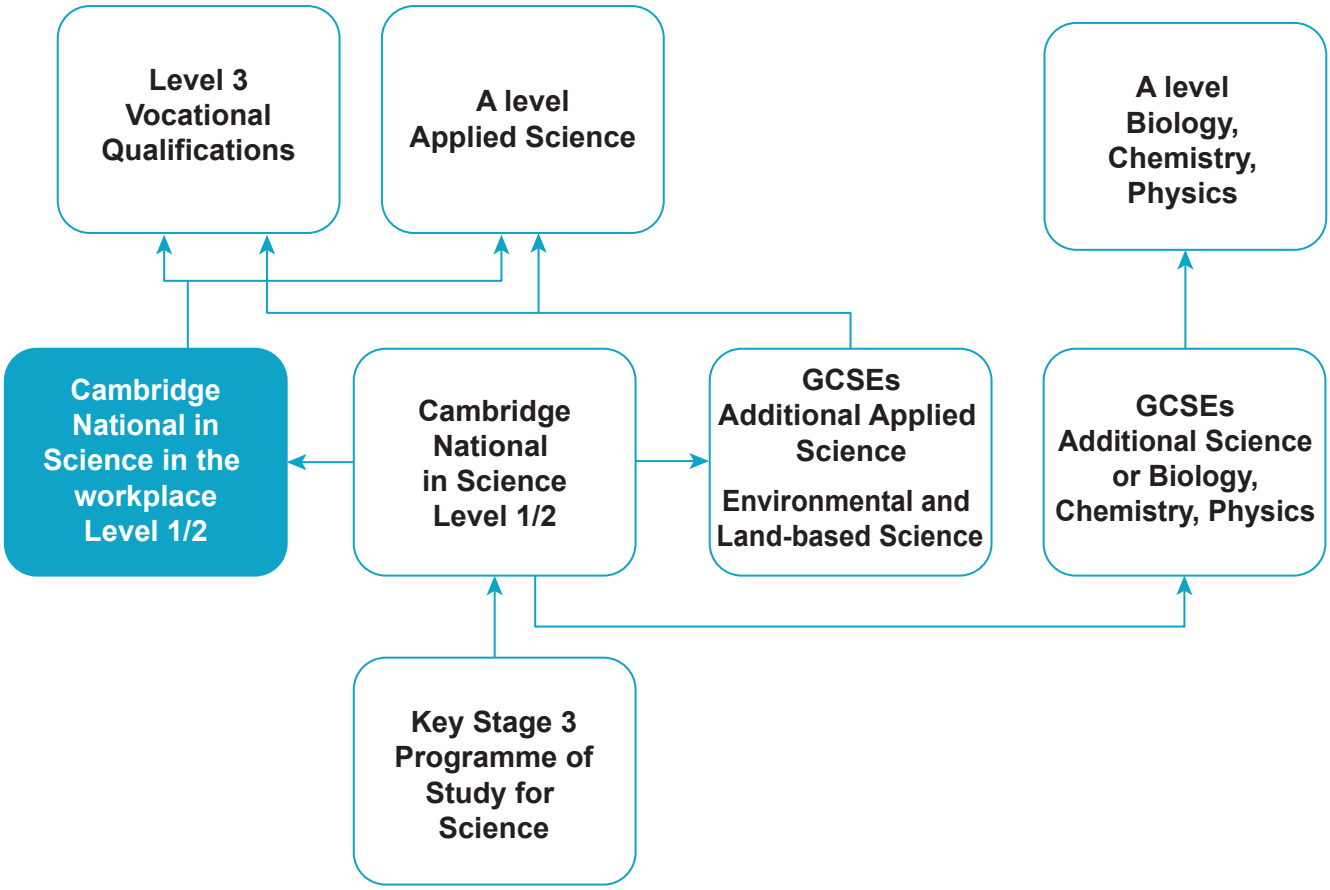
Individual unit results, prior to certification of the qualification, have a shelf-life limited only by that of the qualification.

8 Other information about the Cambridge National Certificate in Science in the Workplace

8.1 Overlap with other qualifications

There is some overlap between the content of this qualification and that of GCSE Additional Applied Science (and the GCSE separate sciences).

8.2 Progression from/to these qualifications



OCR offers a flexible and responsive range of general and vocational qualifications in the sciences that allow suitable progression routes for all types of learners.

Centres are able to use these qualifications to create pathways that provide learners with the underpinning skills and knowledge that will enable them to choose the most appropriate progression routes for their particular needs (further study, Further Education (FE)).

Progression from the Cambridge National Certificate in Science to the Cambridge National Certificate in Science in the Workplace:

- This qualification is designed to be taken alongside or following the OCR Level 1/Level 2 Cambridge National Certificate in Science (or any other Level 1/Level 2 course which covers the National Curriculum Programme of Study for Science at Key Stage 4).
- Progression from this qualification is to Level 3 vocational qualifications (including qualifications in science) or to GCE Applied Science.

Progression from the Cambridge National Certificate in Science in the Workplace to **GCSE qualifications** in *applied science*:

- Additional Applied Science
- Environmental and Land-based Science
- Progression from these qualifications is to Level 3 vocational qualifications (including qualifications in science) or to GCE Applied Science.

Progression from the Cambridge National Certificate in Science in the Workplace to other **GCSE qualifications** in *science*:

- Additional Science
- Separate sciences: Biology, Chemistry, Physics
- Progression from these qualifications is to GCE qualifications in the sciences.

8.3 Avoidance of bias

OCR has taken great care in preparation of this specification and assessment materials to avoid bias of any kind. Special focus is given to the 9 strands of the Equality Act with the aim of ensuring both direct and indirect discrimination is avoided.

8.4 Criteria requirements

This specification complies in all respects with the Ofqual General Conditions of Recognition.

8.5 Language

This specification and associated assessment materials are in English only.

8.6 Spiritual, moral, ethical, social, legislative, economic and cultural issues

This qualification provides potential for centres to develop learners' understanding of spiritual, moral, ethical, social, legislative, economic and cultural issues. This specification offers opportunities to contribute to an understanding of these issues in the following topics.

Issue	Examples of opportunities for developing an understanding of the issue during the course
Spiritual issues Scientific explanations which give an insight into the scale and wonder of natural processes and phenomena.	○ Functions of the human body (unit R077) ○ That stable ecosystems depend upon balanced physical and biological environments (unit R076)
Moral issues The endeavour of scientists in the development of scientific ideas and their commitment to publish their results and to subject their ideas to testing by others.	○ The use of scientific data to support evidence in criminal trials (unit R074) ○ The impact of human activity, including the work of scientists, on the environment and other living organisms (unit R077)
Ethical issues The ethical issues arising from the applications of scientific ideas.	○ Ethical issues arising from making choices about food production (unit R078) ○ Ethical considerations in monitoring health and fitness of individuals (unit R077)
Social issues Social implications of the applications of scientific ideas.	○ The social impact of decisions made about lifestyle choices (unit R077)
Legislative issues Health and safety legislation and its impact on practical work in science.	○ The need to carry out a risk assessment before undertaking practical work (units R074, R076, R077, R078)
Economic issues The range of factors which have to be considered when weighing the costs and benefits of scientific activity; the importance of science to the economy of the UK.	○ The economics of decisions made about yield and optimum production conditions (unit R078) ○ Selection of appropriate analytical techniques (unit R074)
Cultural issues The culture of science.	○ The role of the scientific community in testing and validating products (units R074, R075 and R078)

8.7 Sustainable development, health and safety considerations and European developments, consistent with international agreements

This qualification incorporates work on health and welfare, safety and the environment which encourages learners to develop responsibility for their own health and for the environment, consistent with current EU agreements.

There are opportunities for learners to develop an understanding of sustainable development in:

- the impact of human and natural events on the environment (unit R076)
- how the environment is managed at local and global levels (unit R076).

Heath and safety considerations are important in all practical work in science and the need to carry out a risk assessment before starting practical work is part of the learning and assessment for unit R074. The impact on human health of lifestyle choices is covered in unit R077.

Environmental issues

There are opportunities for learners to develop an understanding of environmental issues in the study of unit R076 Environmental Science.

In units R075, R076 and R077, learners may be given assessment tasks set in contexts related to health, welfare, safety or the environment.

8.8 Key Skills

This qualification provides opportunities for the development of the Key Skills of *Communication, Application of Number, Information and Communication Technology, Working with Others, Improving Own Learning and Performance* and *Problem Solving* at Levels 1 and/or 2. However, the extent to which this evidence fulfils the Key Skills criteria at these levels will be totally dependent on the style of teaching and learning adopted for each unit. The following table indicates where opportunities may exist for at least some coverage of the various Key Skills criteria at Levels 1 and/or 2 for each unit.

Unit	C		AoN		ICT		WwO		IOLP		PS	
	1	2	1	2	1	2	1	2	1	2	1	2
Unit R074	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit R075	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit R076	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit R077	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit R078	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

8.9 Functional Skills

This qualification provides opportunities for the development of the Functional Skills of:

- *English: Speaking and Listening, Reading and Writing*
- *Mathematics: Representing, Analysing and Interpreting*
- *ICT: Use ICT systems, Find and select information and Develop, present and communicate information*

at Levels 1 and 2. However, the extent to which this evidence fulfils the criteria at these levels will be totally dependent on the style of teaching and learning adopted for each unit. The following table indicates where opportunities may exist for at least some coverage of the criteria at Levels 1 and/or 2 for each unit.

Unit	English						Maths						ICT					
	S&L		R		W		R		A		I		U		F&SI		D,P&C	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Unit R074	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit R075	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit R076	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit R077	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unit R078	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Appendix A: Guidance on witness statements

A

It is anticipated that the majority of evidence will be produced directly by the learner. Indirect evidence, such as witness statements, should only be used where it would be impractical for the learner to produce the evidence themselves.

Witness statements will, ideally, support the direct evidence produced by the learner.

- Care should be taken that a witness statement is impartial and free from bias. The use of relatives and close friends as witnesses should be avoided, if possible.
- In all cases the witness will be required to declare their relationship to the learner.
- A witness statement should record what the learner has done and in doing so should not seek to repeat or paraphrase the marking criteria.
- The evidence presented by the witness should record the learner's individual contribution and should focus on the contribution made by the individual learner, as distinct from that of the group or team as a whole.
- Witnesses should describe what the learner did and not assess the learner. It is the responsibility of the teacher/assessor to judge the learner's skill, knowledge and understanding against the marking criteria. In doing so the teacher/assessor will use the witness statement to determine the value of the evidence against the marking criteria and award marks accordingly.
- The teacher/assessor is responsible for briefing anyone who is to provide a witness statement. It is expected that the teacher/assessor will ensure that the witness is appropriately prepared and that any issues related to child protection have been fully considered.
- The role of the witnesses should be that of impartial observers and they should not become involved in carrying out the activity on behalf of the learner.
- In circumstances where a witness does assist the learner in accomplishing a task or activity their input must be recorded within the statement so that the teacher/assessor can reflect this appropriately in the award of marks.

Where the above guidance has not been followed, the reliability of the witness statement may be called into question. In circumstances where doubt exists about the validity of a witness statement, it cannot be used as assessment evidence and no marks may be awarded on the basis of it. If the unreliability of a witness statement becomes apparent during the visiting moderation process, moderators will be instructed to adjust centre marks in accordance with this directive.

An exemplar template for recording a witness statement is available from the OCR website and centres are encouraged to use this to assist in recording witness evidence. However, witness evidence may take different forms including digitally recorded spoken commentary or video. In these cases additional accompanying documentation may be required to corroborate that the guidelines on witness statements detailed above have been followed.

Appendix B: Marking criteria for centre assessment

B

The centre assessed units for this qualification are combined Level 1/Level 2, therefore, the marking criteria for units R074, R075, R076 and R077 span both levels.

Unit R074: *How scientists use analytical techniques to collect data*

Marking criteria guidance

0 marks must be given where there is no evidence or no evidence worthy of credit.

A range of marks is allocated to each learning outcome. Where marks are allocated to a number of statements within a learning outcome, marks should be awarded using a 'best fit' approach. For each of the learning outcomes, one of the descriptors provided in the mark scheme that most closely describes the quality of the work being marked should be selected. Marking should be positive, rewarding achievement rather than penalising failure or omissions. The award of marks **must be** directly related to the marking criteria.

- Each band descriptor covers all the relevant content for the learning outcomes.
- The descriptors should be read and applied as a whole.
- Make a best fit match between the answer and the band descriptors.
- An answer does not have to meet all of the requirements of a band descriptor before being placed in that band. It will be placed in a particular band when it meets more of the requirements of that band than it meets the requirements of other bands.

When deciding the mark within a band, the following criterion should be applied:

- the extent to which the statements within the band have been achieved.

For example:

- an answer that convincingly meets nearly all of the requirements of a band descriptor should be placed at or near the top of that band. Where the learner's work *convincingly* meets the statement, the highest mark should be awarded
- an answer that meets many of the requirements of the band descriptor should be placed in the middle of the band. Where the learner's work *adequately* meets the statement, the most appropriate mark in the middle range should be awarded
- if an answer is on the border-line between two bands but it is decided that it better fits the descriptors for the lower of these two bands, then it should be placed near the top of that lower band. Where the learner's work *just* meets the statement for the higher band, the lowest mark for that higher band should be awarded.

When learners are taking an assessment task, or series of tasks, for this unit they will be able to use relevant, appropriate knowledge, understanding and skills that they will have developed.

For a description of the key words in the marking criteria, please see the *Marking criteria glossary of terms* in Appendix C.

Marking criteria grid

LO1: Be able to apply the principles of good laboratory practice		
MB1: 1–4 marks	**MB2: 5–7 marks**	**MB3: 8–10 marks**
• Demonstrates a **basic** understanding and level of skill when preparing samples, standard solutions and carrying out calibrations • Significant teacher intervention needed to select and carry out the techniques required • **Basic** understanding of hazards and risks in procedures with only standard laboratory safety precautions identified • Significant teacher intervention required to ensure safety **or** help set up equipment • Procedures used for analyses are recorded; observations and measurements are recorded at a **basic** level • **Some** evidence of processing of quantitative data: ○ data presented as **simple** charts or graphs ○ use of **simple** mathematical techniques where appropriate • **Some** trends/patterns in the data identified • **Limited** comments made on the quality of data and procedures used	• Demonstrates a **sufficient** understanding and level of skill when preparing samples, standard solutions and carrying out calibrations • **Independent** selection of techniques and **little support** needed to carry out the techniques required • **Some** hazards and risks in procedures identified, and **some** specific responses suggested to reduce risks • **Most** risks managed successfully with no significant incidents or accidents and no requirements for teacher intervention • **Sufficient** observations and measurements are recorded in an appropriate format • Main trend/patterns **described** with reference to quantitative data ○ **Some relevant** comments made about the quality of the data including accuracy and sources of error, linked to the methods of collection, limitations in the methods of data collection identified and suggestions for improvements given	• Demonstrates a **thorough** understanding and level of skill when preparing samples and standard solutions and calibration • **Independently** carries out the appropriate techniques required • All significant hazards and risks **evaluated** and **reasoned** judgements made to reduce risks • All risks managed successfully with no incidents or accidents and no requirements for teacher intervention • Procedures used for analyses are described in **detail**, justifying the techniques used that will enable the collection of high quality data; observations and measurements are recorded with the necessary detail • Main trends/patterns in the data described in detail and interpreted correctly with reference to quantitative data and **relevant** scientific understanding. **Detailed** and **critical** consideration given to the data and methods used to obtain them: ○ sources of error and quality of data **discussed** and **explained**, including accuracy, repeatability and uncertainty, limitations of the method identified and suggestions for improvements **justified**

LO2: Be able to separate and identify the substances present in a mixture		
MB1: 1–4 marks	**MB2: 5–7 marks**	**MB3: 8–10 marks**
• When provided with method and equipment, **significant support** needed to set it up to take measurements • **Some** measurements taken and recorded • When provided with equation for calculating R_f values, **some** data processed correctly • Types of chromatography to improve analysis of samples identified	• **Independent** selection of equipment to take measurements; **little support** required to set up correctly • Measurements taken and recorded using an **appropriate** format • **Sufficient** observations recorded; measurements taken and recorded using an **appropriate** format • **Support** needed to process data using appropriate mathematical techniques; correct equation for calculating R_f values **independently** selected; **some** calculations carried out correctly and one outcome derived correctly • Appropriate types of chromatography to improve analysis of samples **described**	• **Independent** selection of equipment to take measurements; equipment set up correctly • Measurements taken and recorded to appropriate accuracy and precision using an **appropriate** format, including use of correct units • Data processed accurately using appropriate mathematical techniques; correct equation for calculating R_f values **independently** selected; calculations carried out correctly to appropriate numbers of significant figures • Appropriate types of chromatography to improve analysis of samples described; benefits of their use **explained** and **evaluated**
LO3: Be able to examine and record features of samples		
MB1: 1–4 marks	**MB2: 5–7 marks**	**MB3: 8–10 marks**
• When provided with method and equipment, **significant support** needed to set it up to take measurements and make observations • **Some** measurements taken and recorded • When provided with the mathematical techniques to use, **some** calculations of magnification carried out correctly • Types of instrumental analysis to enhance examination of samples identified	• **Independent** selection of equipment to make observations and take measurements; **little support** needed to set up correctly • **Sufficient** observations recorded; measurements taken and recorded using an **appropriate** format • **Support** needed to process data using appropriate mathematical techniques; correct equations for calculating magnification and scale **independently** selected; **support** needed to manipulate equations and convert units where necessary; **some** calculations carried out correctly and one outcome derived correctly • Appropriate types of instrumental analysis to enhance examination of samples **described**	• **Independent** selection of equipment to take measurements; equipment set up correctly • Measurements taken and recorded to appropriate accuracy and precision using an appropriate format, including use of correct units • Data processed accurately using appropriate mathematical techniques; correct equations for calculating magnification and scale **independently** selected and manipulated where necessary; scale or scale bars calculated correctly to appropriate numbers of significant figures, using appropriate units • Appropriate types of instrumental analysis to enhance examination of samples described; benefits of their use **explained** and **evaluated**

LO4: Be able to identify cations and anions in samples		
MB1: 1–4 marks	**MB2: 5–7 marks**	**MB3: 8–10 marks**
• When provided with method and equipment, **significant support** needed to carry out analyses • **Limited** observations taken and recorded • Types of instrumental analysis to enhance examination of samples identified	• **Independent** selection of equipment to carry out analyses; **little support** needed to set up correctly • **Sufficient** observations recorded using an appropriate level of detail and in an appropriate format • Types of instrumental technique to improve analysis of samples **described**	• **Independent** selection of equipment to carry out analyses; equipment set up correctly • Observations made and recorded **accurately** and in detail, using an appropriate format • **Appropriate** types of instrumental technique to improve analysis of samples described in detail; benefits of their use **explained** and **evaluated**
LO5: Be able to determine the concentration of an acid or base using titration		
MB1: 1–4 marks	**MB2: 5–7 marks**	**MB3: 8–10 marks**
• When provided with method and equipment, **significant support** needed to set it up to take measurements • **Some** measurements taken and recorded • When provided with equations, data substituted correctly and **some** calculations carried out correctly • Instrumental technique to improve analysis of samples by titration identified	• **Independent** selection of indicator and equipment to take measurements; **little support** needed to set up correctly • **Sufficient** observations recorded; measurements taken and recorded using an **appropriate** format • **Support** needed to process data using appropriate mathematical techniques; correct equations **independently** selected; **support** needed to manipulate equations where necessary; some calculations carried out correctly and one outcome derived correctly • Instrumental analysis technique to improve analysis of samples by titration **described**	• **Independent** selection of indicator and equipment to take measurements; equipment set up correctly • Measurements taken and recorded to appropriate accuracy and precision using an appropriate format, including use of correct units • Data processed accurately using appropriate mathematical techniques; correct equations **independently** selected and manipulated where necessary; outcomes calculated correctly to appropriate numbers of significant figures • Appropriate type of instrumental technique to improve analysis of samples by titration described in detail; benefits of its use **explained** and **evaluated**

LO6: Be able to determine the concentration of coloured substances in solution		
MB1: 1–4 marks	**MB2: 5–7 marks**	**MB3: 8–10 marks**
• When provided with method, stock solutions and equipment, **significant support** needed to carry out procedure and to take measurements • **Some** measurements taken and recorded • Calibration curve drawn, with **some** errors in scales and in plotting points • Calibration curve used, with **significant support**, to determine the concentration of a substance in a solution • A type of instrumental technique to improve analysis of samples identified	• **Independent** selection of equipment to take measurements; **little support** needed to carry out procedures correctly • Sufficient measurements taken and recorded • Calibration curve drawn, with suitable scales and minor errors only in plotting of points; **appropriate** line of best fit drawn • Calibration curve used, with **little support**, to determine the concentration of a substance in a solution • A type of instrumental technique to improve analysis of samples **described**	• **Independent** selection of equipment to take measurements; equipment set up correctly • Measurements taken and recorded to appropriate accuracy and precision using an appropriate format, including use of correct units • Calibration curve drawn, with suitable scales and **accurate** plotting of points; **appropriate** line of best fit drawn • Calibration curve used **independently** to determine the concentration of a substance in a solution, to **appropriate** numbers of significant figures • Appropriate type of instrumental technique to improve analysis of samples described in detail; benefits of its use **explained** and **evaluated**

Guide on synoptic assessment

Synoptic assessment is based upon demonstrating a broad understanding of the subject. This is achieved by drawing upon the skills/knowledge/understanding that have been studied across the specification and utilising them in an appropriate and relevant way to complete the assessment for this unit in order to meet the marking criteria for a specific Learning Outcome. When completing work for assessment, learners should be encouraged to apply the **relevant** skills/knowledge/understanding from other units within the specification and not seek to incorporate input from all the previously studied units or content unless it is appropriate to do so. When assessing the learner's work teachers should focus on whether the skills/knowledge/understanding applied are relevant. The links identified below are guidance only and learners may find other skills/knowledge/understanding that they are able to apply synoptically either in addition to or in place of this guidance.

The analytical techniques experienced by learners in unit R074 will form the context for the written unit R075. Some of the techniques used in unit R074 will be applicable to the optional units R076 (measurement and identification of pollutants), R077 (imaging of body systems) and R078 (determining pH and product yields).

Assessment guidance

Outline of assessment tasks	Typical evidence/output of the task
Analytical task (LO1 / LO2) Learners separate and identify substances in a mixture, using chromatography. Learners should review alternative techniques that improve the separation of mixtures and have far greater sensitivity. **Analytical task (LO1 / LO3)** Learners examine and record the features of samples, using visual and microscopical examination. Learners demonstrate an understanding of the importance of recording observations accurately, how to take measurements, and how to calculate magnification and scale. Learners should review alternative techniques to light microscopy. **Analytical task (LO1 / LO4)** Learners carry out flame tests and chemical tests that can be used to identify ions and analyse unknowns. Learners should develop skills that enable them to discuss the limitations of these tests. Learners should review alternative techniques that can improve the separation and identification of cations and anions in samples. **Analytical task (LO1 / LO5)** Learners use acid-base titrations to determine the concentration of acids or bases/ alkalis. Learners will choose appropriate indicators for particular titrations, use calculations to determine the concentration of an acid or alkali. Learners should review alternative techniques offering enhanced accuracy and sensitivity. **Analytical task (LO1 / LO6)** Learners determine the concentration of coloured substances in solution. Learners should collect data and draw calibration curves using appropriate lines of best fit, then use these to determine the concentration of substances. Learners should review alternative techniques offering enhanced accuracy and sensitivity.	Learners produce a Laboratory Notebook incorporating the assessment tasks. Material is likely to be in a variety of forms to meet the requirements of presenting a range of different types of evidence, including graphical presentations of quantitative information, pictures etc. and could include the use of ICT. Witness statements of learners' ability to select and set up equipment. Written record of the measurements taken and the calculations necessary to derive the outcomes required.

Unit R076: *Environmental science*

Marking criteria guidance

0 marks must be given where there is no evidence or no evidence worthy of credit.

A range of marks is allocated to each learning outcome. Where marks are allocated to a number of statements within a learning outcome, marks should be awarded using a 'best fit' approach. For each of the learning outcomes, one of the descriptors provided in the mark scheme that most closely describes the quality of the work being marked should be selected. Marking should be positive, rewarding achievement rather than penalising failure or omissions. The award of marks **must be** directly related to the marking criteria.

- Each band descriptor covers all the relevant content for the learning outcomes.
- The descriptors should be read and applied as a whole.
- Make a best fit match between the answer and the band descriptors.
- An answer does not have to meet all of the requirements of a band descriptor before being placed in that band. It will be placed in a particular band when it meets more of the requirements of that band than it meets the requirements of other bands.

When deciding the mark within a band, the following criteria should be applied:

- the extent to which the statements within the band have been achieved.

For example:

- an answer that convincingly meets nearly all of the requirements of a band descriptor should be placed at or near the top of that band. Where the learner's work *convincingly* meets the statement, the highest mark should be awarded
- an answer that meets many of the requirements of the band descriptor should be placed in the middle of the band. Where the learner's work *adequately* meets the statement, the most appropriate mark in the middle range should be awarded
- if an answer is on the border-line between two bands but it is decided that it better fits the descriptors for the lower of these two bands, then it should be placed near the top of that band. Where the learner's work *just* meets the statement for the higher band, the lowest mark for that band should be awarded.

When learners are taking an assessment task, or series of tasks, for this unit they will be able to use relevant, appropriate knowledge, understanding and skills that they will have developed.

For a description of the key words in the marking criteria, please see the *Marking criteria glossary of terms* in Appendix C.

Marking criteria grid

LO1: Understand that stable ecosystems depend on balanced physical and biological environments

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–15 marks
• **Basic** definition of an ecosystem and environment • **Basic** knowledge of the abiotic and biotic components of ecosystems • **Basic** explanation of how ecosystems remain in balance • **Basic** linkage to the carbon cycle, nitrogen cycle, and water cycle	• **Detailed** definition of an ecosystem and environment • **Detailed** knowledge of the abiotic and biotic components of ecosystems • **Limited** explanation with qualitative data of how ecosystems remain in balance • **Limited** linkage to the carbon cycle, nitrogen cycle, and water cycle	• **Thorough** definition of an ecosystem and environment • **Thorough** knowledge of the abiotic and biotic components of ecosystems • **Detailed** explanation with quantitative data of how ecosystems remain in balance • **Detailed** linkage to the carbon cycle, nitrogen cycle, and water cycle

LO2: Understand the impact of human and natural events on the environment

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–15 marks
• **Lists** how the environment can be affected by human and natural events • **Limited** linkage of the effects of human and natural events to the environmental consequences • **Some** understanding of the outcomes of the impact of human and natural events on the environment	• **Limited** description of how the environment can be affected by human and natural events • **Detailed** linkage of the effect of human and natural events to the environmental consequences • **Detailed** understanding of outcomes of the impact of human and natural events on the environment	• **Detailed** description how the environment can be affected by human and natural events • Well **justified** linkage of the effect of human and natural events to the environmental consequences • **Thorough** understanding of the outcomes of the impact of human and natural events on the environment

LO3: Understand how physical conditions in the environment are monitored at local and global levels

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–15 marks
• **Lists** of techniques and instruments that can be used to monitor physical conditions in the environment at local and global levels • **Basic** description of the consequences to the environment of the conditions monitored	• **Limited** description of techniques and instruments that can be used to monitor physical conditions in the environment at local and global levels • **Limited** description of the consequences to the environment of the conditions monitored	• **Detailed** description of techniques and instruments that can be used to monitor physical conditions in the environment at local and global levels • **Detailed** description with **relevant** quantitative data of the consequences to the environment of the conditions monitored

LO4: Be able to use standard procedures to monitor physical factors within the environment		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Lists** physical conditions that can be measured to monitor the environment • When provided with method and equipment, **some support** needed to take a series of measurements of physical conditions within an environment • **Some** measurements taken and recorded • When provided with mathematical techniques to use, **some** data processed correctly	• **Limited** description of physical conditions that are measured to monitor the environment • **Independent** selection of equipment to take a series of measurements of physical conditions within an environment; **little support** needed to set up equipment correctly • Measurements taken and recorded using an **appropriate** format • **Support** needed to process data using **appropriate** mathematical techniques	• **Detailed** description of physical conditions that are measured to monitor the environment • **Independent** selection of equipment to take a series of measurements of physical conditions within an environment; equipment set up correctly • Measurements taken and recorded to **appropriate** accuracy and precision using an **appropriate** format, including use of correct units • Data processed **accurately** using **appropriate** mathematical techniques to identify trends or patterns
LO5: Be able to use standard procedures to measure the degree of pollution in the environment		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• When provided with method and equipment, **some support** needed to set up and take measurements to measure the degree of pollution in an environmental sample • **Some** measurements taken and recorded • When provided with mathematical techniques to use, **some** data processed correctly	• Independent selection of equipment to carry out tests; **little support** needed to set up correctly • Measurements taken and recorded using an **appropriate** format • **Support** needed to process data using **appropriate** mathematical techniques	• **Independent** selection of equipment to take measurements; equipment set up correctly; • Measurements taken and recorded to **appropriate** accuracy and precision using an **appropriate** format, including use of correct units • Data processed **accurately** using **appropriate** mathematical techniques to identify trends or patterns
LO6: Understand how the environment is managed at local and global levels		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Lists** measures used to manage and preserve environments • **Lists** measures used to repair the environment	• **Limited** description and **justification** of measures used to manage and preserve environments • **Limited** description of measures used to repair the environment	• **Detailed** description and **justification** of measures used to manage and preserve environments • **Detailed** description of measures used to repair the environment

LO7: Be able to describe the purpose and structure of an organisation related to the environment		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Basic** description of the purpose and structure of an organisation related to the environment • Information provided is **limited**. Tutor guidance may be required to find and select appropriate information.	• **Detailed** description of the purpose and structure of an organisation related to the environment • Information provided is **detailed**. Minimal tutor guidance is required to find and select appropriate information	• **Thorough** description of the purpose and structure of an organisation related to the environment • Information provided is **comprehensive**. Research is carried out **independently**.
LO8: Be able to research career options within an environmental organisation		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Lists** sources of information on career areas within the environmental sector • **Basic** information on career areas within the environmental sector • **Basic** information about opportunities for career areas within the environmental sector	• Information provided is **detailed**. Minimal tutor guidance is required to find and select appropriate information on career areas within the environmental sector • **Detailed** information on career areas within the environmental sector • **Detailed** information about opportunities for career areas within the environmental sector	• Information provided is **comprehensive**. Research is carried out **independently**. • **Thorough** information on career areas within the environmental sector • **Thorough** information about opportunities for career areas within the environmental sector

Guidance on synoptic assessment

Synoptic assessment is based upon demonstrating a broad understanding of the subject. This is achieved by drawing upon the skills/knowledge/understanding that have been studied across the specification and utilising them in an appropriate and relevant way to complete the assessment for this unit in order to meet the marking criteria for a specific Learning Outcome. When completing work for assessment, learners should be encouraged to apply the **relevant** skills/knowledge/understanding from other units within the specification and not seek to incorporate input from all the previously studied units or content unless it is appropriate to do so. When assessing the learner's work teachers should focus on whether the skills/knowledge/understanding applied are relevant. The links identified below are guidance only and learners may find other skills/knowledge/understanding that they are able to apply synoptically either in addition to or in place of this guidance.

The learning outcomes relating to practical activities build on some of the analytical techniques used in unit R074, and the principles of good laboratory practice. The wider principles of analysis and evaluation from unit R075 will be applied by learners to the contexts in this unit.

Assessment guidance

Outline of assessment tasks	Typical evidence/output of the task
Analytical task (LO1/LO2) Learners consider the ways that the biological and physical environments are in balance, the possible ways in which human and natural events impact on the environment, and how these can be monitored at a local and global level.	Material is likely to be in a variety of forms to meet the requirements of presenting a range of different types of evidence, including graphical presentations of quantitative information, pictures etc. and could include the use of ICT, posters, videos, as well as answers to a possible survey.
Practical procedures (LO3/LO4/LO5) Learners use standard procedures to measure the physical conditions and the level of pollution within the environment.	A variety of forms of material including witness statements of the learners' ability to select and set up equipment. Written record of the measurements taken and calculations necessary to derive the outcomes necessary.
Analytical task (LO6) Learners consider how the Earth's physical and biological environment can be maintained, preserved and if necessary repaired.	Material is likely to be in a variety of forms to meet the requirements of presenting a range of different types of evidence, including graphical presentations of quantitative information, pictures etc. and could include the use of ICT, posters, videos, as well as answers to a possible survey.
Research report (LO7/LO8) Learners produce briefing material that will explain the workings of an organisation operating in the environmental sector.	Material could be in a number of forms, such as a PowerPoint presentation, a short video, an article or a leaflet.

Unit R077: *The science of fitness and health*

Marking criteria guidance

0 marks must be given where there is no evidence or no evidence worthy of credit.

A range of marks is allocated to each learning outcome. Where marks are allocated to a number of statements within a learning outcome, marks should be awarded using a 'best fit' approach. For each of the learning outcomes, one of the descriptors provided in the mark scheme that most closely describes the quality of the work being marked should be selected. Marking should be positive, rewarding achievement rather than penalising failure or omissions. The award of marks **must be** directly related to the marking criteria.

- Each band descriptor covers all the relevant content for the learning outcomes.
- The descriptors should be read and applied as a whole.
- Make a best fit match between the answer and the band descriptors.
- An answer does not have to meet all of the requirements of a band descriptor before being placed in that band. It will be placed in a particular band when it meets more of the requirements of that band than it meets the requirements of other bands.

When deciding the mark within a band, the following criterion should be applied:

- the extent to which the statements within the band have been achieved.

For example:

- an answer that convincingly meets nearly all of the requirements of a band descriptor should be placed at or near the top of that band. Where the learner's work *convincingly* meets the statement, the highest mark should be awarded
- an answer that meets many of the requirements of the band descriptor should be placed in the middle of the band. Where the learner's work *adequately* meets the statement, the most appropriate mark in the middle range should be awarded
- if an answer is on the border-line between two bands but it is decided that it better fits the descriptors for the lower of these two bands, then it should be placed near the top of that lower band. Where the learner's work *just* meets the statement for the higher band, the lowest mark for that higher band should be awarded.

When learners are taking an assessment task, or series of tasks, for this unit they will be able to use relevant, appropriate knowledge, understanding and skills that they will have developed.

For a description of the key words in the marking criteria, please see the *Marking criteria glossary of terms* in Appendix C.

Marking criteria grid

LO1: Understand the structure, function and control of the musculoskeletal system		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• A **few** components of the musculoskeletal system identified • **Basic** understanding of the functions of the musculoskeletal system • **Limited** analysis of how the musculoskeletal system is affected by health and fitness	• **Some** components of the musculoskeletal system identified • **Detailed** understanding of the functions of the musculoskeletal system • **Some detailed** analysis of how the musculoskeletal system is affected by health and fitness	• **Most** components of the musculoskeletal system identified • **Thorough** understanding of the functions of the musculoskeletal system • **Detailed** analysis of how the musculoskeletal system is affected by health and fitness • Quantitative data displayed in **appropriate** formats
LO2: Understand the structure, function and control of the circulatory system		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• A **few** components of the circulatory system identified • **Basic** understanding of the functions of the circulatory system • **Limited** analysis of how the circulatory system is affected by health and fitness	• **Some** components of the circulatory system identified • **Detailed** understanding of the functions of the circulatory system • **Some detailed** analysis of how the circulatory system is affected by health and fitness	• **Most** components of the circulatory system identified • **Thorough** understanding of the functions of the circulatory system • **Detailed** analysis of how circulatory system is affected by health and fitness • Quantitative data displayed in **appropriate** formats
LO3: Understand the structure, function and control of the respiratory system		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• A **few** components of the respiratory system identified • **Basic** understanding of the functions of the respiratory system • **Limited** analysis of how the respiratory system is affected by health and fitness	• **Some** components of the respiratory system identified • **Detailed** understanding of the functions of the respiratory system • **Some detailed** analysis of how the respiratory system is affected by health and fitness	• **Most** components of the respiratory system identified • **Thorough** understanding of the functions of the respiratory system • **Detailed** analysis of how the respiratory system is affected by health and fitness • Quantitative data displayed in **appropriate** formats

LO4: Understand the consequences of health and fitness factors on the body		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Lists** different human health risks • **Basic** understanding of the risks of an unhealthy lifestyle • **Limited** qualitative judgement of the risks of an unhealthy life style	• **Limited** description of the different human health risks • **Detailed** understanding of the effects of an unhealthy lifestyle • **Simple** quantitative judgement of the risks of an unhealthy lifestyle	• **Detailed** description of the different human health risks • **Thorough** understanding of the effects of an unhealthy lifestyle • **Detailed** quantitative judgement of the of the risks of an unhealthy lifestyle • Quantitative data displayed in **appropriate** formats
LO5: Be able to create a fitness programme for a specified group		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Lists some** components that fitness depends on • **Basic** understanding of the how the components effect fitness • **Limited** qualitative data displayed on the proposed impact of a fitness programme • **Some** materials used to design a fitness programme	• **Description** of the components that fitness depends on and how they affect the health and fitness of a specified group • **Some** quantitative data displayed on the proposed impact of a fitness programme • Materials used to design a fitness programme are **relevant** to the needs of the specified group	• **Detailed** explanation of the components that fitness depends on how they affect the health and fitness of a specified group • A **range** of **relevant** quantitative data on the proposed impact of a fitness programme are displayed accurately in appropriate formats • Materials used to design a fitness programme are **concise** and **relevant** to the needs of the specified group
LO6: Be able to measure a person's fitness		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• When provided with method and equipment, **some support** needed to set up equipment in order to carry out measurements on fitness and performance • **Some** data collected and recorded	• **Independent** selection of equipment to carry out measurements on fitness and performance; **little support** needed to set up equipment correctly • Measurements taken and recorded in an **appropriate** format	• **Independent** selection of equipment to carry out measurements on fitness and performance; equipment set up correctly • Measurements taken and recorded to **appropriate** accuracy and precision using an appropriate format, including use of correct units

LO7: Describe the purpose and structure of an organisation related to the sports or health and fitness industry		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Basic** description of the purpose and structure of an organisation related to the sports or health and fitness industry • Information provided is **limited**. Tutor guidance may be required to find and select appropriate information	• **Detailed** description of the purpose and structure of an organisation related to the sports or health and fitness industry • Information provided is **detailed**. **Minimal** tutor guidance is required to find and select appropriate information	• **Thorough** description of the purpose and structure of an organisation related to the sports or health and fitness industry • Information provided is **comprehensive**. Research is carried out **independently**
LO8: Be able to research career options within a sports or health and fitness organisation		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Lists** sources of information on career areas within the sports or health and fitness sector • **Basic** information on career areas within the health and fitness sector • **Basic** information about opportunities for career areas within the sports or health and fitness sector	• Information provided is **detailed**. **Minimal** tutor guidance is required to find and select appropriate information on career areas within the sports or health and fitness sector • **Detailed** information on career areas within the health and fitness sector • **Detailed** information about opportunities for career areas within the sports or health and fitness sector	• Information provided is **comprehensive**. Research is carried out **independently** • **Thorough** information on career areas within the sports or health and fitness sector • **Thorough** information about opportunities for career areas within the sports or health and fitness sector

Guidance on synoptic assessment

Synoptic assessment is based upon demonstrating a broad understanding of the subject. This is achieved by drawing upon the skills/knowledge/understanding that have been studied across the specification and utilising them in an appropriate and relevant way to complete the assessment for this unit in order to meet the marking criteria for a specific Learning Outcome. When completing work for assessment, learners should be encouraged to apply the **relevant** skills/knowledge/understanding from other units within the specification and not seek to incorporate input from all the previously studied units or content unless it is appropriate to do so. When assessing the learner's work teachers should focus on whether the skills/knowledge/understanding applied are relevant. The links identified below are guidance only and learners may find other skills/knowledge/understanding that they are able to apply synoptically either in addition to or in place of this guidance.

The learning outcomes relating to practical activities build on some of the analytical techniques used in unit R074, and the principles of good laboratory practice. The wider principles of analysis and evaluation from unit R075 will be applied by learners to the contexts in this unit.

Assessment guidance

Outline of assessment tasks	Typical evidence/output of the task
Analytical task (LO1/LO2/LO3) Learners consider how the structure, function and control of body systems affect health and fitness.	Material is likely to be in a variety of forms to meet the requirements of presenting a range of different types of evidence, including graphical presentations of quantitative information, pictures etc. and could include the use of ICT, posters, videos.
Analytical task (LO4) Learners consider how possible lifestyles can be followed to optimise the health and fitness of a person.	Material is likely to be in a variety of forms to meet the requirements of presenting a range of different types of evidence, including graphical presentations of quantitative information, pictures etc. and could include the use of ICT, posters, videos.
Practical procedures (LO5/LO6) Learners create a fitness programme for a specified group and use ways to measure its effectiveness.	Material is likely to be in a variety of forms to present a fitness programme. Witness statements of the learners' ability to carry out tests. Written record of the measurements taken and calculations necessary to derive the outcomes necessary.
Research report (LO7/LO8) Learners produce briefing material, for example for a careers fair, that will explain a career in sports or health and fitness organisation.	Material could be in a number of forms, such as a PowerPoint presentation, a short video, an article or a leaflet.

Unit R078: *The science of production*

Marking criteria guidance

0 marks must be given where there is no evidence or no evidence worthy of credit.

A range of marks is allocated to each learning outcome. Where marks are allocated to a number of statements within a learning outcome, marks should be awarded using a 'best fit' approach. For each of the learning outcomes, one of the descriptors provided in the mark scheme that most closely describes the quality of the work being marked should be selected. Marking should be positive, rewarding achievement rather than penalising failure or omissions. The award of marks **must be** directly related to the marking criteria.

- Each band descriptor covers all the relevant content for the learning outcomes.
- The descriptors should be read and applied as a whole.
- Make a best fit match between the answer and the band descriptors.
- An answer does not have to meet all of the requirements of a band descriptor before being placed in that band. It will be placed in a particular band when it meets more of the requirements of that band than it meets the requirements of other bands.

When deciding the mark within a band, the following criterion should be applied:

- the extent to which the statements within the band have been achieved.

For example:

- an answer that convincingly meets nearly all of the requirements of a band descriptor should be placed at or near the top of that band. Where the learner's work *convincingly* meets the statement, the highest mark should be awarded
- an answer that meets many of the requirements of the band descriptor should be placed in the middle of the band. Where the learner's work *adequately* meets the statement, the most appropriate mark in the middle range should be awarded
- if an answer is on the border-line between two bands but it is decided that it better fits the descriptors for the lower of these two bands, then it should be placed near the top of that lower band. Where the learner's work *just* meets the statement for the higher band, the lowest mark for that higher band should be awarded.

When learners are taking an assessment task, or series of tasks, for this unit they will be able to use relevant, appropriate knowledge, understanding and skills that they will have developed.

For a description of the key words in the marking criteria, please see the *Marking criteria glossary of terms* in Appendix C.

Marking criteria grid

LO1: Understand how to produce bulk chemicals by neutralisation

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–15 marks
• **Lists** commercially important chemicals that can be produced by neutralisation • **Basic** knowledge of neutralisation including a statement describing the process	• Lists and **describes** some uses of commercially important chemicals that can be produced by neutralisation • **Detailed** knowledge of how soluble salts can be made by neutralisation, including use of a word equation	• Lists and describes some uses of commercially important chemicals that can be produced by neutralisation; **explains** why these chemicals are important • **Thorough** knowledge of how soluble salts can be made by neutralisation including correct and appropriate use of balanced symbol equations and chemical nomenclature

LO2: Be able to produce a bulk chemical by neutralisation and determine its yield

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–15 marks
• When provided with method and equipment, **some support** needed to set up equipment in order to produce a bulk chemical by neutralisation • **Some** data collected and recorded on yield and quality of product	• **Independent** selection of equipment to carry out production of a bulk chemical by neutralisation; **little support** needed to set up equipment correctly • Measurements on yield and quality of product, recorded using an **appropriate** format	• **Independent** selection of equipment to carry out production of a bulk chemical by neutralisation; equipment set up correctly • Measurements taken and recorded to **appropriate accuracy** and precision using an appropriate format, including use of correct units

LO3: Understand the factors that affect the growth of plants for commercial production

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–15 marks
• **Lists** factors that affect plant growth • **Basic** understanding of how the factors affecting plant growth can be altered to optimise growth	• List the factors that affect plant growth and provides a **limited** description of the how they affect plant growth • **Detailed** understanding of how the factors affecting plant growth can be altered to optimise growth	• List the factors that affect plant growth and provides a **detailed** description of how they affect plant growth • **Thorough** understanding of how the factors affecting plant growth can be altered to optimise growth

LO4: Be able to monitor the growth of a plant grown for commercial production		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• When provided with method and equipment, **some support** needed to set up equipment in order to monitor the growth of a plant grown for commercial production • **Some** measurements taken and recorded	• **Independent** selection of equipment to monitor the growth of a plant grown for commercial production; **little support** needed to set up equipment correctly • Measurements taken and recorded using an **appropriate** format	• **Independent** selection of equipment to monitor the growth of a plant grown for commercial production; equipment set up correctly • Measurements taken and recorded to **appropriate** accuracy and precision using an appropriate format, including use of correct units
LO5: Understand how products are made by microorganisms		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Lists** useful products produced by microorganisms • **Lists** the conditions required to produce useful products made by microorganisms • **Basic** understanding of why conditions affect the product production of microorganisms	• Lists useful products produced by microorganisms and provides a **limited** description of how these products are made • **Limited** description of the conditions required to produce a range of useful products by microorganisms • **Detailed** understanding of why conditions affect production by microorganisms	• Lists useful products produced by microorganisms and provides a **detailed** description of how these products are made • **Detailed** description of the conditions required to produce a wide range of useful products by microorganisms • **Thorough** understanding of why conditions affect production by microorganisms
LO6: Be able to determine the optimum conditions for production of a product by a microorganism		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• When provided with method and equipment, **some support** needed to set up equipment in choosing the conditions and to monitor product production • **Some** measurements taken and recorded	• **Independent** selection of equipment to monitor product production; **little support** needed to set up equipment correctly • Measurements taken and recorded using an **appropriate** format	• **Independent** selection of equipment and conditions when monitoring product production; equipment set up correctly • Measurements taken and recorded to **appropriate accuracy** and precision using an appropriate format, including use of correct units

LO7: Describe the purpose and structure of an organisation related to an organisation that produces products		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Basic** description of the purpose and structure of an organisation related to an organisation that produces products • Information provided is **limited**. Tutor guidance may be required to find and select appropriate information	• **Detailed** description of the purpose and structure of an organisation that produces products • Information provided is **detailed**. **Minimal** tutor guidance is required to find and select appropriate information	• **Thorough** description of the purpose and structure of an organisation that produces products • Information provided is **comprehensive**. Research is carried out **independently**

LO8: Be able to research career options within an organisation that produces products		
MB1: 1–5 marks	**MB2: 6–10 marks**	**MB3: 11–15 marks**
• **Lists** sources of information on career areas within an organisation that works in the production sector • **Basic** information on career areas within an organisation that works in the production sector • **Basic** information about opportunities for career areas within an organisation that works in the production sector	• Information provided is **detailed**. **Minimal** tutor guidance is required to find and select appropriate information on career areas within an organisation that works in the production sector • **Detailed** information on career areas within an organisation that works in the production sector • **Detailed** information about opportunities for career areas within an organisation that works in the production sector	• Information provided is **comprehensive**. Research is carried out **independently** on career areas within an organisation that works in the production sector • **Thorough** information on career areas within an organisation that works in the production sector • **Thorough** information about opportunities for career areas within an organisation that works in the production sector

Guidance on synoptic assessment

Synoptic assessment is based upon demonstrating a broad understanding of the subject. This is achieved by drawing upon the skills/knowledge/understanding that have been studied across the specification and utilising them in an appropriate and relevant way to complete the assessment for this unit in order to meet the marking criteria for a specific Learning Outcome. When completing work for assessment, learners should be encouraged to apply the **relevant** skills/knowledge/understanding from other units within the specification and not seek to incorporate input from all the previously studied units or content unless it is appropriate to do so. When assessing the learner's work teachers should focus on whether the skills/knowledge/understanding applied are relevant. The links identified below are guidance only and learners may find other skills/knowledge/understanding that they are able to apply synoptically either in addition to or in place of this guidance.

The learning outcomes relating to practical activities build on some of the analytical techniques used in unit R074, and the principles of good laboratory practice. The wider principles of analysis and evaluation from unit R075 will be applied by learners to the contexts in this unit.

Assessment guidance

Outline of assessment tasks	Typical evidence/output of the task
Practical task (LO1/LO2) Learners consider the production of bulk chemicals using neutralisation reactions in chemical manufacturing. Learners produce their chosen bulk chemical and test the success of the production.	Material is likely to be in a variety of forms to meet the requirements of presenting a range of different types of evidence, including graphical presentations of quantitative information, pictures etc. and could include the use of ICT, posters, videos.
Analytical/practical task (LO3/LO4) Learners consider the factors that affect the growth of commercially important plants. They monitor the growth of a chosen plant that would be grown for commercial production.	Witness statements of the learner's ability to select and set up equipment. Written record of the measurements taken and calculations necessary to derive the outcomes necessary.
Analytical/practical task (LO5/LO6) Learners consider how useful products are made by microorganisms. They then determine the optimum conditions for microorganisms to produce products and select appropriate methods for determining yield.	
Research report (LO8/LO9) Learners produce briefing material, for example for other students that will explain a career in a production organisation.	Material could be in a number of forms, such as a PowerPoint presentation, a short video, an article or a leaflet.

Appendix C: Marking criteria glossary of terms

C

Accurately	Acting or performing within care and precision; within acceptable limits from a standard
Appropriate	Relevant to the purpose/task
Basic	The work comprises the minimum required and provides the base or starting point from which to develop. Responses are simple and not complicated; the simplest and most important facts are included
Comprehensive	The work is complete and includes everything that is necessary to evidence understanding in terms of both breadth and depth
Concise	Expressing or covering much in few words; brief in form but comprehensive in scope; succinct
Considered	Reached after or carried out with careful thought
Critical	Incisive – exposing/recognising flaws
Describe	Set out characteristics
Detail	To describe something item by item, giving all the facts
Detailed	Point-by-point consideration of e.g. analysis, argument
Discuss	Present, explain and evaluate salient points e.g. for/against an argument
Evaluate	Make a qualitative judgement taking into account different factors and using available knowledge/experience
Explain	Set out the purposes or reasons
Few	A small number or amount, not many but more than one
Independently	Without reliance on others
Imaginative	New, original and clever; creative
Independent	Not relying on another or others for support or guidance
Justified	Present a reasoned case; the reasons for doing something are explained in full
Limited	The work produced is small in range or scope and includes only a part of the information required; it evidences partial, rather than full, understanding
List	Document a series of outcomes or events or information
Little	A very small amount of evidence, or low number of examples, compared to what was expected, is included in the work
Minimal	Relating to or being a minimum/least possible
Most	Greatest in amount; the majority of; nearly all of; at least 75% of the content which is expected has been included

Range	The evidence presented is sufficiently varied to give confidence that the knowledge and principles are understood in application as well as in fact
Reasoned	Justified, to understand and to make judgments based on practical facts
Relevant	Correctly focused on the activity
Simple	The work is composed of one part only, either in terms of its demands or in relation to how a more complex task has been interpreted by the learner
Some	About 50% of the content which would have been expected is included
Sound	Valid, logical, justifiable, well reasoned
Structured	Having a clearly defined structure or organisation
Sufficient	Adequate for the purpose; enough to meet a need or purpose
Support	Teacher gives training, instruction, guidance and advice as appropriate and monitors activities to assist learners in tackling/ completing their projects, ensuring authenticity and a fair and accurate assessment
Thorough	Extremely attentive to accuracy and detail

Appendix D: Mathematics skills

D

Learners are permitted to use calculators in all assessments.

Learners should be able to:

- understand number size and scale and the quantitative relationship between units
- understand when and how to use estimation
- carry out calculations involving +, – , ×, ÷, either singly or in combination, decimals, fractions, percentages and positive whole number powers
- provide answers to calculations to an appropriate number of significant figures
- understand and use the symbols =, <, >, ~
- understand and use direct proportion and simple ratios
- calculate arithmetic means
- understand and use common measures and simple compound measures such as speed
- plot and draw graphs (line graphs, bar charts, pie charts, scatter graphs, histograms) selecting appropriate scales for the axes
- substitute numerical values into simple formulae and equations using appropriate units
- translate information between graphical and numeric form
- extract and interpret information from charts, graphs and tables
- understand the idea of probability
- calculate area, perimeters and volumes of simple shapes.

In addition, Level 2 learners should be able to:

- interpret, order and calculate with numbers written in standard form
- carry out calculations involving negative powers (only –1 for rate)
- change the subject of an equation
- understand and use inverse proportion
- understand and use percentiles and deciles.

E Appendix E: Health and safety

In UK law, health and safety is the responsibility of the employer. For most establishments entering learners for Nationals for Schools, this is likely to be the local education authority or the governing body. Employees, ie teachers and lecturers, have a duty to cooperate with their employer on health and safety matters. Various regulations, but especially the COSHH Regulations 2002 and the Management of Health and Safety at Work Regulations 1999, require that before any activity involving a hazardous procedure or harmful micro-organisms is carried out, or hazardous chemicals are used or made, the employer must provide a risk assessment. A useful summary of the requirements for risk assessment in school or college science can be found at www.ase.org.uk/resources/health-and-safety-resources.

For members, the CLEAPSS® guide, *Managing Risk Assessment in Science** offers detailed advice. Most education employers have adopted a range of nationally available publications as the basis for their Model Risk Assessments. Those commonly used include:

Safety in Science Education, DfEE, 1996, HMSO, ISBN 0 11 270915 X.

Now out of print but sections are available at:
www.ase.org.uk/resources/health-and-safety-resources;

Topics in Safety, 3rd edition, 2001, ASE ISBN 0 86357 316 9;

Safeguards in the School Laboratory, 11th edition, 2006, ASE ISBN 978 0 86357 408 5;

CLEAPSS® *Hazcards*, 2007 edition and later updates*;

CLEAPSS® *Laboratory Handbook**;

Hazardous Chemicals, A Manual for Science Education, 1997, SSERC Limited

ISBN 0 9531776 0 2 (see www.sserc.org.uk/index.php/health-a-safety).

Where an employer has adopted these or other publications as the basis of their model risk assessments, an individual school or college then has to review them, to see if there is a need to modify or adapt them in some way to suit the particular conditions of the establishment.

Such adaptations might include a reduced scale of working, deciding that the fume cupboard provision was inadequate or the skills of the learners were insufficient to attempt particular activities safely. The significant findings of such risk assessment should then be recorded, for example on schemes of work, published teachers' guides, work sheets, etc. There is no specific legal requirement that detailed risk assessment forms should be completed, although a few employers require this.

Where project work or individual investigations, sometimes linked to work-related activities, are included in specifications this may well lead to the use of novel procedures, chemicals or micro-organisms, which are not covered by the employer's model risk assessments. The employer should have given guidance on how to proceed in such cases. Often, for members, it will involve contacting CLEAPSS® (or, in Scotland, SSERC).

*These, and other CLEAPSS® publications, are on the CLEAPSS® Science Publications CD-ROM issued annually to members. Note that CLEAPSS® publications are only available to members. For more information about CLEAPSS® go to www.cleapss.org.uk. In Scotland, SSERC (www.sserc.org.uk) has a similar role to CLEAPSS® and there are some reciprocal arrangements.

Appendix F: Physical quantities and units

F

It is expected that candidates will show an understanding of the physical quantities and corresponding SI units listed below and will be able to use them in quantitative work and calculations. Whenever they are required for such questions, units will be provided and, where necessary, explained.

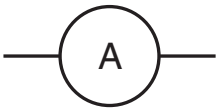
Fundamental physical quantities	
Physical quantity	Unit(s)
length	metre (m); kilometre (km); centimetre (cm); millimetre (mm)
mass	kilogram (kg); gram (g); milligram (mg)
time	second (s); millisecond (ms); year (a); million years (Ma); billion years (Ga)
temperature	degree Celsius (°C); kelvin (K)
current	ampere (A); milliampere (mA)

Derived quantities and units	
Physical quantity	Unit(s)
area	mm^2; cm^2; m^2
volume	cm^3; dm^3; m^3; litre (*l*); millilitre (ml)
density	kg/m^3; g/cm^3
force	newton (N)
gravitational field strength	N/kg
pressure	N/m^2; pascal (Pa)
speed, velocity	m/s; km/h
acceleration	m/s^2; km/h^2
energy	joule (J); kilojoule (kJ); megajoule (MJ); kilowatt hour (kWh); megawatt hour (MWh)
power	watt (W); kilowatt (kW); megawatt (MW)
resistance	ohm (Ω)
voltage	volt (V); millivolt (mV)
specific heat capacity	J/kg°C
frequency	hertz (Hz); kilohertz (kHz); megahertz (MHz); gigahertz (GHz)
radioactivity	becquerel (Bq)
radiation dose	sievert (Sv)
information	bit (b); bytes (B); kilobytes (kB); megabytes (MB)

G Appendix G: Electrical symbols

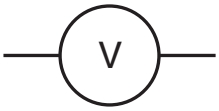
Junction of Conductors

Ammeter

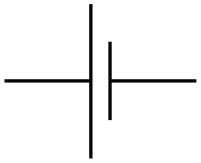


Switch

Voltmeter



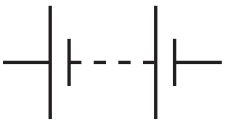
Primary or secondary cell



Indicator or light source

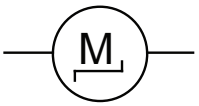
Battery of cells

or

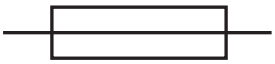


Power supply

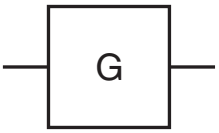
Motor



Fuse

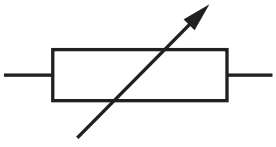


Generator

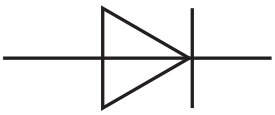


Fixed resistor

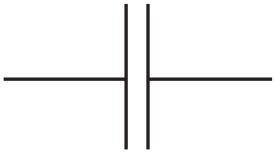
Variable resistor



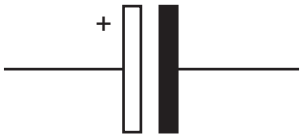
Diode



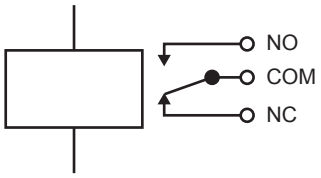
Capacitor



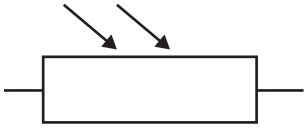
Electrolytic capacitor



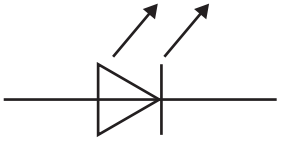
Relay



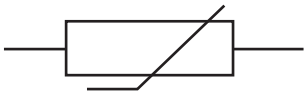
Light dependent resistor (LDR)



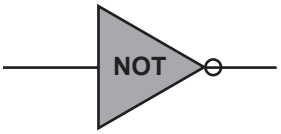
Light emitting diode (LED)



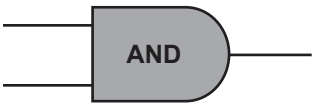
Thermistor



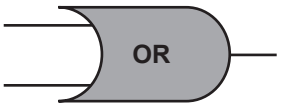
NOT gate



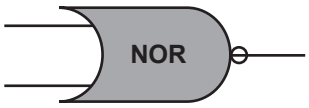
AND gate



OR gate



NOR gate



NAND gate

Appendix H: Periodic Table

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

Appendix I: Guidance for the production of electronic internal assessment

I

Structure for evidence

The centre assessed units are comprised of units R074, R076, R077 and R078. For each learner, all the tasks together will form a portfolio of evidence, stored electronically. Evidence for each unit must be stored separately.

An internal assessment portfolio is a collection of folders and files containing the learner's evidence. Folders should be organised in a structured way so that the evidence can be accessed easily by a teacher or moderator. This structure is commonly known as a folder tree. It would be helpful if the location of particular evidence is made clear by naming each file and folder appropriately and by use of an index called 'Home Page'.

There should be a top level folder detailing the learner's centre number, OCR candidate number, surname and forename, together with the unit code (R074, R076, R077 or R078), so that the portfolio is clearly identified as the work of one learner.

Each learner's internal assessment portfolio should be stored in a secure area on the centre's network. Prior to submitting the portfolio to OCR, the centre should add a folder to the folder tree containing the internal assessment and summary forms.

Data formats for evidence

In order to minimise software and hardware compatibility issues it will be necessary to save learners' work using an appropriate file format.

Learners must use formats appropriate to the evidence that they are providing and appropriate to viewing for assessment and moderation. Open file formats or proprietary formats for which a downloadable reader or player is available are acceptable. Where this is not available, the file format is not acceptable.

Centre assessed tasks are designed to give learners an opportunity to demonstrate what they know, understand and can do using current technology. Learners do not gain marks for using more sophisticated formats or for using a range of formats. A learner who chooses to use only digital photographs (as required by the specification) and word documents will not be disadvantaged by that choice.

Evidence submitted is likely to be in the form of word processed documents, PowerPoint presentations, digital photos and digital video.

To ensure compatibility, all files submitted must be in the formats listed below. Where new formats become available that might be acceptable, OCR will provide further guidance. OCR advises against changing the file format that the document was originally created in. It is the centre's responsibility to ensure that the electronic portfolios submitted for moderation are accessible to the moderator and fully represent the evidence available for each learner.

Accepted File Formats
Movie formats for digital video evidence
MPEG (*.mpg)
QuickTime movie (*.mov)
Macromedia Shockwave (*.aam)
Macromedia Shockwave (*.dcr)
Flash (*.swf)
Windows Media File (*.wmf)
MPEG Video Layer 4 (*.mp4)
Audio or sound formats
MPEG Audio Layer 3 (*.mp3)
Graphics formats including photographic evidence
JPEG (*.jpg)
Graphics file (*.pcx)
MS bitmap (*.bmp)
GIF images (*.gif)
Animation formats
Macromedia Flash (*.fla)
Structured markup formats
XML (*xml)
Text formats
Comma Separated Values (.csv)
PDF (.pdf)
Rich text format (.rtf)
Text document (.txt)
Microsoft Office suite
PowerPoint (.ppt)
Word (.doc)
Excel (.xls)
Visio (.vsd)
Project (.mpp)

Your checklist

Our aim is to provide you with all the information and support you need to deliver our specifications.

- ☑ Bookmark **www.ocr.org.uk/cambridgenationals**
- ☑ Be among the first to hear about support materials and resources as they become available. Register for email updates at **www.ocr.org.uk/cambridgenationals**
- ☑ Join our social network community for teachers at **www.social.ocr.org.uk**

Need more help?

Here's how to contact us for specialist advice:

Phone: 02476 851509
Email: cambridgenationals@ocr.org.uk
Online: http://answers.ocr.org.uk
Fax: 01223 552627
Post: Customer Contact Centre, OCR, Progress House, Westwood Business Park, Coventry CV4 8JQ

What to do next

1) Sign up to teach – let us know you will be teaching this specification to ensure you receive the support you need. Simply visit **www.ocr.org.uk/cambridgenationals** for more information.

2) Become an approved OCR centre – if your centre is completely new to OCR and has not previously used us for any examinations, visit **http://www.ocr.org.uk/i-want-to/become-an-approved-centre/** to become an approved OCR centre.

For more information visit
ocr.org.uk/cambridgenationals
or call our Customer Contact Centre on
01223 553998

Alternatively, you can email us on
vocational.qualifications@ocr.org.uk

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