BTEC FIRST

BTEC

Award

Specification

PRINCIPLES OF APPLIED SCIENCE

From September 2012

Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science

Issue 2

ALWAYS LEARNING

PEARSON

Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science

Specification

First teaching September 2012

Issue 2

Pearson Education Limited is one of the UK's largest awarding organisations, offering academic and vocational qualifications and testing to schools, colleges, employers and other places of learning, both in the UK and internationally. Qualifications offered include GCSE, AS and A Level, NVQ and our BTEC suite of vocational qualifications, ranging from Entry Level to BTEC Higher National Diplomas. Pearson Education Limited administers BTEC qualifications.

Through initiatives such as onscreen marking and administration, Pearson is leading the way in using technology to modernise educational assessment, and to support teachers and learners.

This specification is Issue 2. Key changes are sidelined, with the most recent in red. We will inform centres of any changes to this issue. The latest issue can be found on our website.

References to third-party material made in this specification are made in good faith. We do not endorse, approve or accept responsibility for the content of materials, which may be subject to change, or any opinions expressed therein. (Material may include textbooks, journals, magazines and other publications and websites.)

ISBN 978 1 446 93725 9

Welcome to your BTEC First 2012 specification

For more than 25 years, BTECs have earned their reputation as well-established, enduringly effective qualifications. They have a proven track record in improving motivation and achievement among young learners. Additionally, BTECs provide progression routes to the next stage of education or into employment.

BTECs are evolving

Informed by recent policy developments, including the *Review of Vocational Education – The Wolf Report* (March 2011), we have designed this new suite of BTEC Firsts to:

- ensure high quality and rigorous standards
- conform to quality criteria for non-GCSE qualifications
- be fit for purpose for learners, pre- or post-16, in schools and in colleges.

We conducted in-depth, independent consultations with schools, colleges, higher education, employers, the Association of Colleges and other professional organisations. This new suite builds on the qualities – such as a clear vocational context for learning and teacher-led assessment based on centre-devised assignments – that you told us make BTECs so effective and engaging.

This new suite introduces features to meet the needs of educators, employers and the external environment. They are fully aligned with requirements for progression – to further study at level 3, into an apprenticeship or into the workplace. We believe these features will make BTEC even stronger and more highly valued.

What are the key principles of the new suite of BTEC Firsts?

To support young people to succeed and progress in their education, we have drawn on our consultations with you and embedded some key design principles into the new BTEC Firsts.

1 Standards: a common core and external assessment

Each new Level 2 BTEC First Award has an essential core of knowledge and applied skills. We have introduced external assessment appropriate to the sector. This provides independent evidence of learning and progression alongside the predominantly portfolio-based assessment.

2 Quality: a robust quality-assurance model

Building on strong foundations, we have further developed our quality-assurance model to ensure robust support for learners, centres and assessors.

We will make sure that:

- every BTEC learner's work is independently scrutinised through the external assessment process
- every BTEC assessor will take part in a sampling and quality review during the teaching cycle
- we visit each BTEC centre every year to review and support your quality processes.

We believe this combination of rigour, dialogue and support will underpin the validity of the teacher-led assessment and the learner-centric approach that lie at the heart of BTEC learning.

3 Breadth and progression: a range of options building on the core; contextualised English and mathematics

The **essential core**, developed in consultation with employers and educators, gives learners the opportunity to gain a broad understanding and knowledge of a vocational sector.

Opportunities to develop skills in English and mathematics are indicated in the units where appropriate. These give learners the opportunity to practise these essential skills in naturally occurring and meaningful contexts, where appropriate to the sector. The skills have been mapped against GCSE (including functional elements) English and mathematics subject content areas.

4 Recognising achievement: opportunity to achieve at level 1

The new BTEC Firsts are a level 2 qualification, graded at Pass, Merit, Distinction and Distinction*.

However, we recognise that some learners may fail to achieve a full Pass at Level 2, so we have included the opportunity for learners to gain a level 1 qualification.

Improved specification and support

In our consultation, we also asked about what kind of guidance you, as teachers and tutors, need. As a result, we have streamlined the specification itself to make the units easier to navigate, and provided enhanced support in the accompanying Delivery Guide.

Thank you

Finally, we would like to extend our thanks to everyone who provided support and feedback during the development of the new BTEC Firsts, particularly all of you who gave up many evenings of your own time to share your advice and experiences to shape these new qualifications. We hope you enjoy teaching the course.

Summary of a Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science specification Issue 2 additional change

Summary of an additional change made between previous issues and this current issue	Page number
In *Section 9*, the assessment availability dates for the external assessment units have been changed.	Page 29

Contents

Purpose of this specification

This specification sets out:

- the qualification's objective
- any other qualification that a learner must have completed before taking the qualification
- any prior knowledge, skills or understanding that the learner is required to have before taking the qualification
- units that a learner must have completed before the qualification will be awarded, and any optional routes
- any other requirements that a learner must have satisfied before the learner will be assessed, or before the qualification will be awarded
- the knowledge, skills and understanding that will be assessed as part of the qualification (giving a clear indication of their coverage and depth)
- the method of any assessment and any associated requirements relating to it
- the criteria against which learners' level of attainment will be measured (such as assessment criteria)
- any specimen materials (supplied separately)
- any specified levels of attainment.

Source: Ofqual – *General conditions of recognition May 2011*

Qualification title and Qualification Number

Qualification title	**Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science**
Qualification Number (QN)	**600/4787/2**

This qualification is on the Regulated Qualifications Framework (RQF). It is eligible for public funding as determined by the Department for Education (DfE) under Section 96 of the Learning and Skills Act 2000.

This qualification title features in the DfE funding lists.

Your centre should use the Qualification Number (QN) when seeking funding for your learners or for league table reporting.

The qualification title, units and QN will appear on each learner's final certificate. You should tell your learners this when your centre recruits them and registers them with us. Further information about certification is in the *Information Manual* on our website, qualifications.pearson.com.

1 What are BTEC Firsts?

BTEC First qualifications were originally designed for use in colleges, schools and the workplace as an introductory level 2 course for learners wanting to study in the context of a vocational sector. This is still relevant today. The skills learnt in studying a BTEC First will aid progression to further study and prepare learners to enter the workplace in due course. In Applied Science typical employment opportunities may be as a laboratory technician or in roles involving sample analysis in environmental protection or healthcare.

These qualifications are intended primarily for learners in the 14–19 age group, but may also be used by other learners who wish to gain an introductory understanding of a vocational area. When taken as part of a balanced curriculum they have a clear progression route to a level 3 course or to an apprenticeship.

BTECs are vocationally related qualifications, where learners develop knowledge and understanding by applying their learning and skills in a work-related context. Additionally, they are popular and effective because they engage learners to take responsibility for their own learning and to develop skills that are essential for the modern-day workplace. These skills include: teamworking; working from a prescribed brief; working to deadlines; presenting information effectively; and accurately completing administrative tasks and processes. BTEC Firsts motivate learners, and open doors to progression into further study and responsibility within the workplace.

The new BTEC First suite continues to reflect this ethos and build on the recommendations outlined in the *Review of Vocational Education – The Wolf Report* (March 2011). That report confirmed the importance of a broad and balanced curriculum for all learners.

The BTEC First suite of qualifications

The following qualifications are part of the BTEC First suite for first teaching from September 2012:

- Application of Science
- Art and Design
- Business
- Engineering
- Health and Social Care
- Information and Creative Technology
- Performing Arts
- Principles of Applied Science
- Sport.

Additional qualifications in larger sizes and in different vocational sectors will be available from 2012.

Objectives of the BTEC First suite

The BTEC First suite will:

- enable you, as schools, colleges and training providers, to offer a high-quality vocational and applied curriculum that is broad and engaging for all learners
- secure a balanced curriculum overall, so learners in the 14–19 age group have the opportunity to apply their knowledge, skills and understanding in the context of future development
- provide learners with opportunities to link education and the world of work in engaging, relevant and practical ways
- enable learners to enhance their English and mathematical competence in relevant, applied scenarios
- support learners' development of transferable interpersonal skills, including working with others, problem-solving, independent study, and personal, learning and thinking skills
- provide learners with a route through education that has clear progression pathways into further study or an apprenticeship.

Breadth and progression

This qualification has a core of underpinning knowledge, skills and understanding. This gives learners the opportunity to:

- gain a broad understanding and knowledge of a vocational sector
- investigate areas of specific interest
- develop essential skills and attributes prized by employers, further education colleges and higher education institutions.

This suite of qualifications provides opportunities for learners to progress to either academic or more specialised vocational pathways.

2 Key features of the Pearson BTEC First Award

The Pearson BTEC Level 1/Level 2 First Award:

- is a level 2 qualification; however, it is graded at Level 2 Pass, Level 2 Merit, Level 2 Distinction, Level 2 Distinction*, Level 1 and Unclassified
- is for learners aged 14 years and over
- is a 120 guided-learning-hour qualification (equivalent in teaching time to one GCSE)
- has 25 per cent of the qualification that is externally assessed. Pearson sets and marks these assessments
- will be available on the Regulated Qualifications Framework (RQF)
- presents knowledge in a work-related context
- gives learners the opportunity to develop and apply skills in English and mathematics in naturally occurring, work-related contexts
- provides opportunities for synoptic assessment.

Learners can register on the Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science from April 2012. The first certification opportunity for the Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science will be in 2013.

Types of units within the qualification

The Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science has mandatory units only. See *Section 4* for more detailed information.

Mandatory units

- This qualification has mandatory units totalling 120 guided learning hours.
- Mandatory units cover the body of content that employers and educators within the sector consider essential for 14–19 year-old learners
- One of the mandatory units is externally assessed.

Total qualification time (TQT)

For all regulated qualifications, Pearson specifies a total number of hours that it is expected learners will be required to undertake in order to complete and show achievement for the qualification: this is the Total Qualification Time (TQT). The TQT value indicates the size of a qualification.

Within this, Pearson will also identify the number of Guided Learning Hours (GLH) that we expect a centre delivering the qualification will need to provide. Guided learning means activities that directly or immediately involve tutors and assessors in teaching, supervising, and invigilating learners, such as lessons, tutorials, online instruction and supervised study.

In addition to guided learning, other required learning directed by tutors or assessors will include private study, preparation for assessment and undertaking assessment when not under supervision, such as preparatory reading, revision and independent research.

Qualifications can also have a credit value, which is equal to one tenth of TQT, rounded to the nearest whole number.

Qualification sizes for BTEC Firsts in the Applied Science sector

This suite of BTEC Firsts for the Applied Science sector is available in the following sizes:

	GLH	**TQT**
First award	120	160
First extended certificate	360	480
First diploma	480	640

Pearson BTEC Level 1/ Level 2 First Award in Principles of Applied Science

3 Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science

Applied Science adopts a different structure from other qualifications in the suite, to reflect the unique nature of science learning. To ensure sufficient breadth and depth, instead of a single Award, Applied Science has two Awards. This specification is for the Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science. There is an additional specification for the Pearson BTEC Level 1/Level 2 First Award in Applications of Science.

The Principles of Applied Science Award delivers the Key Stage 4 Programme of Study for science by covering the key scientific principles vital for both scientists and citizens of the future. It develops and exemplifies these principles in applied and vocational contexts, leading to an understanding of how the principles are applied in practice. As a result, the external assessment is based on key principles of science from the Programme of Study for Science that underpin further learning.

Given the fact that some students are clearly best suited and more interested in vocational learning at the beginning of Key Stage 4, a vocational qualification designed to cover the Programme of Study is appropriate. However, some students need a different learning route at Key Stage 4, either due to constraints on resources in schools or because they themselves are unsure of the learning route they wish to take. For these, learning the Programme of Study via an academic route, such as GCSE Science, is appropriate. However, having studied in this way, they may then take the decision that a vocational learning route is their best option for further progression or employment. In such circumstances, we have provided an option to follow a vocational learning programme that does not repeat the Programme of Study for Science.

The Application of Science Award is suitable for these learners. It develops the learner's understanding of key applications of science, and builds the skills required both for the scientific workplace and for further study. New knowledge is acquired and applied through the internally assessed units. The final unit is an external assessment of investigative skills to ensure that all learners who have completed two qualifications in Science, using either a fully vocational route or a route beginning with an academic course and being completed with a vocational course, can investigate effectively in a practical context scientific problems that are not familiar, since the ability to do this is vital to progression to vocational qualifications at level 3 or employment in technical roles.

Rationale for the Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science

The Principles of Applied Science Award has been designed to deliver the Key Stage 4 Programme of Study for science by covering the key scientific principles vital for both scientists and citizens of the future. The qualification is appropriate for learners of all abilities who will benefit from a practical and applied approach to learning in a vocational context. It has been developed to:

- exemplify scientific principles in vocational contexts, leading to an understanding of how those principles are applied in practice, and can facilitate a move either onto further periods of study or into employment.
- give learners the opportunity to gain a broad understanding and knowledge of science principles and practice

- give learners the opportunity to develop a range of related skills and techniques that are essential for successful performance in working life
- give opportunities for learners to achieve a nationally recognised level 1 or level 2 science qualification
- support progression into a more specialised level 3 vocational or academic course or into an apprenticeship
- give full-time learners the opportunity to enter potential employment within a wide range of science sectors such as process, industrial, medical, or forensic.

Vocational learning in science is critical to enabling technical roles in the STEM sector to be supported. The qualification is appropriate for learners of all abilities who benefit from a practical and applied approach to learning in a vocational context. From the knowledge and skills developed in this qualification you may expect to seek employment at a junior level working in companies that manufacture pharmaceuticals, computer-chip technology materials and food products; or in companies that investigate the causes of disease and help to combat pollution; or with energy companies and those that manufacture products reliant upon energy.

The Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science has been designed primarily for young people aged 14–19 who may wish to explore a vocational route throughout Key Stage 4. It provides an engaging, robust, broad-based introduction to applied science principles. The underpinning knowledge, understanding and practical skills which make up this qualification reflect the needs of employers and higher and further education professionals. It presents knowledge, skills and understanding in a meaningful work-related context, to allow learners to understand theory and application.

The Award comprises four mandatory units that underpin the knowledge and skills that are key to progression within science based industries. These mandatory units cover the range of essential scientific principles together with underlying introductions to essential knowledge and applications in chemistry, physics and biology. English and mathematics have been contextualised within the assessment aims. This allows learners to practise these essential skills in naturally occurring and meaningful contexts, where appropriate.

This qualification includes an externally assessed unit that deals with science principles. The approach for the internally assessed units provides opportunities to explore beyond these principles into vocationally linked activities and enables learners to receive feedback on their progress throughout the course as they provide evidence towards meeting the unit assessment criteria.

Locally available vocational examples and the opportunity to localise assignments to fit learner experience allow a more realistic and motivating basis for learning and can start to ensure learning serves the needs of local areas.

Employers value employees who are able to communicate effectively both verbally and using electronic communication methods. The qualification provides opportunities for learners to develop their communication skills as they progress through the course. This can be achieved through presentations and in discussions where they have the opportunity to express their opinions.

Learners should be encouraged to take responsibility for their own learning and achievement, taking account of the industry standards for behaviour and performance.

Progression opportunities

This qualification builds on a foundation of the Key Stage 3 science Programme of Study.

Learners should progress from this qualification to the Pearson BTEC Level 1/ Level 2 First Award in Application of Science. Learners can then progress to the BTEC Level 3 Nationals in Applied Science, including the Forensic Science and Medical Science endorsed pathways. Learners can also progress to a range of BTEC Level 2 National qualifications in related areas such as Beauty Therapy Science, Health and Social Care, Sport and Exercise Science, Engineering, Construction, Land-based, Pharmacy Services or Dental Technology.

Alternatively, they can progress to NVQs such as the Laboratory and Associated Technical Activities or Laboratory Science. The underpinning knowledge, practical and vocational scientific skills learnt on the BTEC course will enhance and support the progression to a competency-based course.

For learners who wish to progress to GCEs in science it is recommended that they also take further units from the larger-sized BTEC First qualifications and are provided with support on GCE assessment methods.

Stakeholder support

The Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science reflects the needs of employers, further and higher education representatives and professional organisations. Key stakeholders were consulted during the development of this qualification. Stakeholders included employers and teachers who deliver vocational qualifications at levels 2 and 3.

4 Qualification structure

The Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science is taught over 120 guided learning hours (GLH). It has four mandatory units.

Learners must complete all mandatory units.

This BTEC First Award has units that your centre assesses (internal) and a unit that Pearson sets and marks (external).

Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science			
Unit	**Mandatory units**	**Assessment method**	**GLH**
1	Principles of Science	External	30
2	Chemistry and Our Earth	Internal	30
3	Energy and Our Universe	Internal	30
4	Biology and Our Environment	Internal	30

5 Programme delivery

Pearson does not define the mode of study for BTEC qualifications. Your centre is free to offer the qualification using any mode of delivery (such as full-time, part-time, evening only or distance learning) that meets your learners' needs. As such, those already employed in the applied science sector could study for the BTEC First Award on a part-time basis, using industry knowledge and expertise gained from the workplace to develop evidence towards meeting the unit assessment criteria.

Whichever mode of delivery is used, your centre must ensure that learners have appropriate access to the resources identified in the specification and to the subject specialists who are delivering the units. This is particularly important for learners studying for the qualification through open or distance learning.

When planning the programme, you should aim to enhance the vocational nature of this qualification by:

- using up-to-date and relevant teaching materials that make use of scenarios relevant to the scope and variety of employment opportunities available in the sector. These materials may be drawn from workplace settings where this is feasible. For example, in science drawing upon local industrial processes that can exemplify the way firms draw upon scientific principles in manufacturing
- giving learners the opportunity to apply their learning through practical activities to be found in the workplace. For example, how key principles of biology, chemistry and physics and investigative techniques underpin how scientific organisations operate
- including employers in the delivery of the programme and, where appropriate, in the assessment. You may, for example, wish to seek the cooperation of local employers to provide examples of current work procedures and practices
- liaising with employers to make sure a course is relevant to learners' specific needs. You may, for example, wish to seek employer help in stressing the importance of effective teamwork, verbal and written communication, and mathematical skills in ensuring good laboratory practice.

Resources

As part of the approval process, your centre must make sure that the resource requirements below are in place before offering the qualification.

- Centres must have appropriate physical resources (for example, equipment, IT, learning materials, teaching rooms) to support the delivery and assessment of this qualification.
- Staff involved in the assessment process must have relevant expertise and/or occupational experience.
- There must be systems in place to ensure continuing professional development for staff delivering the qualification.
- Centres must have appropriate health-and-safety policies in place relating to the use of equipment by learners.
- Centres must deliver the qualification in accordance with current equality legislation.
- Your centre should refer to the Teacher guidance section in individual units to check for any specific resources required.

Delivery approach

Your approach to teaching and learning should support the specialist vocational nature of BTEC First qualifications. These BTEC Firsts give a balance of practical skill development and knowledge requirements, some of which can be theoretical in nature.

Instruction in the classroom is only part of the learning process. You can reinforce the links between the theory and practical application, and make sure that the knowledge base is relevant and up to date, by teaching through practical work, group work, and including investigations set in local contexts.

One of the important aspects of your approach to delivery should be to instil into learners who have a limited experience of the world of work some insights into the daily operations that are met in the vocational area being studied. It is suggested that the delivery of the BTEC First Awards can be enriched and extended by the use of learning materials, classroom exercises and internal assessments that draw on current practice in, and experience of, the qualification sector being studied. This may draw on the use of:

- vocationally specific workplace case-study materials, e.g. local scientific companies
- visiting speakers, and the assistance of local employers, e.g. NHS Trusts
- visits by learners to local workplaces , e.g. local government departments responsible for monitoring the environment
- inviting in relevant parents or contacts to come and speak to the learners about how they use science in their work
- arranging controlled mystery experiments, which the learners have to solve in pair or group work
- asking a local employer to set them a problem-solving activity to be carried out in groups.

Personal, learning and thinking skills

Your learners have opportunities to develop personal, learning and thinking skills (PLTS) within a sector-related context. See *Annexe A* for detailed information about PLTS, and mapping to the units in this specification.

English and mathematics knowledge and skills

It is likely that learners will be working towards English and mathematics qualifications at Key Stage 4 or above. This BTEC First qualification provides further opportunity to enhance and reinforce skills in English and mathematics in naturally occurring, relevant, work-related contexts.

English and mathematical skills are embedded in the assessment criteria where appropriate – see individual units for signposting to English (#) and mathematics (*), *Annexe B* for mapping to GCSE English subject criteria (including functional elements), and *Annexe C* for mapping to the GCSE Mathematics subject criteria (including functional elements).

Health and safety

Learners must observe safe practice when they are carrying out practical work. It is the responsibility of centres to carry out risk assessments for all practical work that they undertake with their learners.

During any internal assessment, learners should be responsible for their own practical work, such as planning and collecting data. However, you, as teachers, should always check and supervise this for health and safety reasons.

6 Access and recruitment

Our policy regarding access to our qualifications is that:

- they should be available to everyone who is capable of reaching the required standards
- they should be free from any barriers that restrict access and progression
- there should be equal opportunities for all those wishing to access the qualifications.

This is a qualification aimed at level 2 learners. Your centre is required to recruit learners to BTEC First qualifications with integrity.

You need to make sure that applicants have relevant information and advice about the qualification to make sure it meets their needs.

Your centre should review the applicant's prior qualifications and/or experience to consider whether this profile shows that they have the potential to achieve the qualification.

For learners with disabilities and specific needs, this review will need to take account of the support available to the learner during the teaching and assessment of the qualification.

Prior knowledge, skills and understanding

Learners do not need to achieve any other qualifications before registering for the Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science. No prior knowledge or skills are necessary. There are no specific requirements for this qualification.

Access to qualifications for learners with disabilities or specific needs

Equality and fairness are central to our work. Our equality policy requires that all learners should have equal opportunity to access our qualifications and assessments, and that our qualifications are awarded in a way that is fair to every learner.

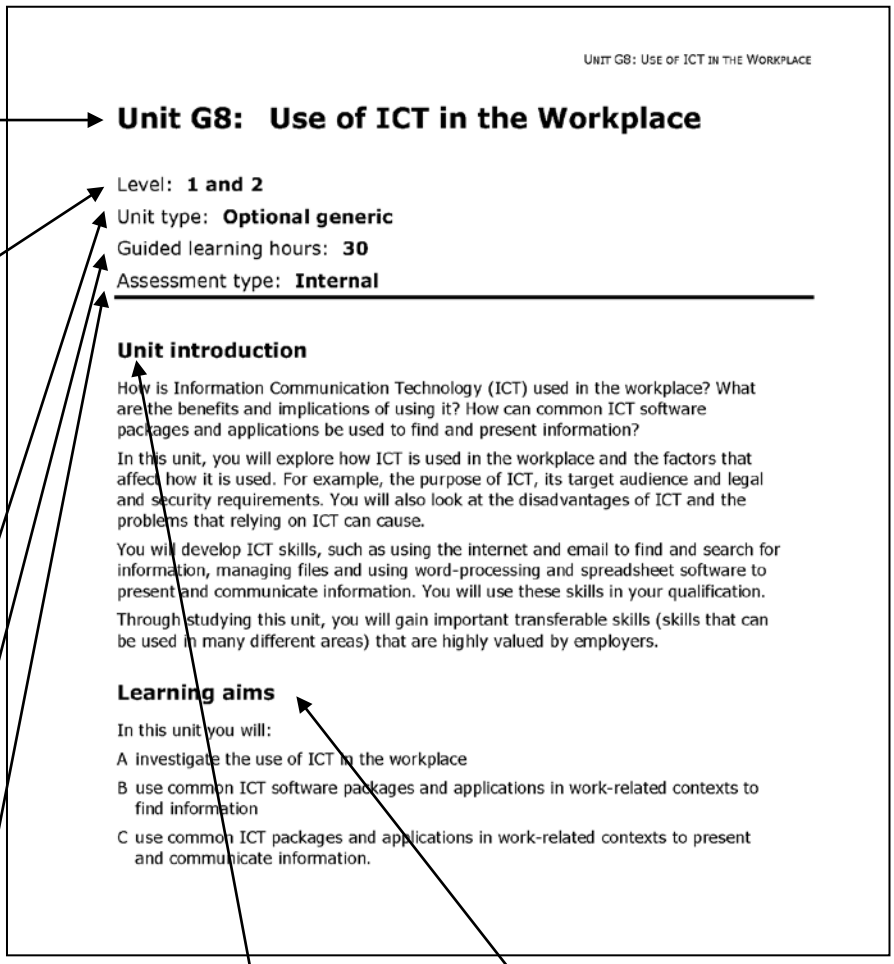
We are committed to making sure that:

- learners with a protected characteristic (as defined by the Equality Act 2010) are not, when they are undertaking one of our qualifications, disadvantaged in comparison to learners who do not share that characteristic
- all learners achieve the recognition they deserve for undertaking a qualification and that this achievement can be compared fairly to the achievement of their peers.

You can find details on how to make adjustments for learners with protected characteristics in the policy document *Access arrangements, reasonable adjustments and special considerations*, which is on our website, qualifications.pearson.com.

7 The layout of units in the specification

Each unit is laid out using the headings given below. The unit shown below is for illustrative purposes only.



UNIT G8: USE OF ICT IN THE WORKPLACE

Unit G8: Use of ICT in the Workplace

Level: **1 and 2**
Unit type: **Optional generic**
Guided learning hours: **30**
Assessment type: **Internal**

Unit introduction

How is Information Communication Technology (ICT) used in the workplace? What are the benefits and implications of using it? How can common ICT software packages and applications be used to find and present information?

In this unit, you will explore how ICT is used in the workplace and the factors that affect how it is used. For example, the purpose of ICT, its target audience and legal and security requirements. You will also look at the disadvantages of ICT and the problems that relying on ICT can cause.

You will develop ICT skills, such as using the internet and email to find and search for information, managing files and using word-processing and spreadsheet software to present and communicate information. You will use these skills in your qualification.

Through studying this unit, you will gain important transferable skills (skills that can be used in many different areas) that are highly valued by employers.

Learning aims

In this unit you will:

A investigate the use of ICT in the workplace

B use common ICT software packages and applications in work-related contexts to find information

C use common ICT packages and applications in work-related contexts to present and communicate information.

Unit title
The title reflects the content of the unit.

Level
All units and qualifications have a level assigned to them that represents the level of achievement. The National Qualifications Framework level descriptors and similar qualifications at this level inform the allocation of the unit level.

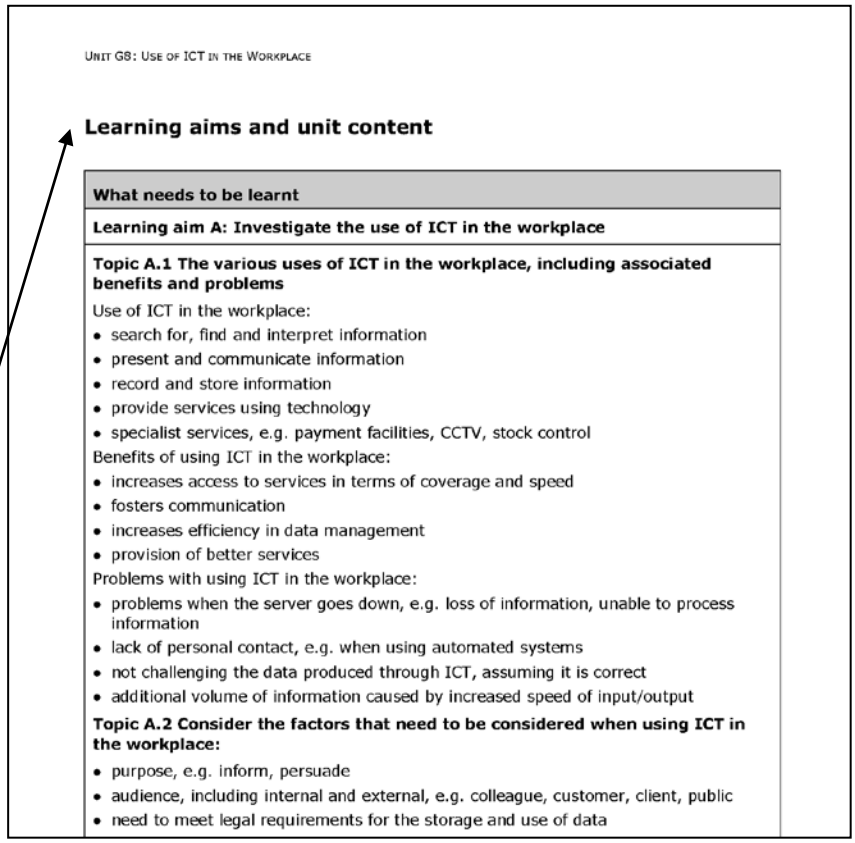
Unit type
This section shows if the unit is mandatory, specialist or generic.

Guided learning hours
All units have guided learning hours assigned to them. This is the time when you (as a teacher, tutor, trainer or facilitator) are present to give specific guidance to learners on the unit content.

Assessment type
Units are either internally or externally assessed. Your centre designs and assesses the internal assessments. Pearson sets and marks the external assessments.

Unit introduction
The unit introduction is addressed to the learner and gives the learner a snapshot of the purpose of the unit.

Learning aims
The learning aims are statements indicating the scope of learning for the unit. They provide a holistic overview of the unit when considered alongside the unit content.



UNIT G8: USE OF ICT IN THE WORKPLACE

Learning aims and unit content

What needs to be learnt
Learning aim A: Investigate the use of ICT in the workplace
Topic A.1 The various uses of ICT in the workplace, including associated benefits and problems Use of ICT in the workplace: • search for, find and interpret information • present and communicate information • record and store information • provide services using technology • specialist services, e.g. payment facilities, CCTV, stock control Benefits of using ICT in the workplace: • increases access to services in terms of coverage and speed • fosters communication • increases efficiency in data management • provision of better services Problems with using ICT in the workplace: • problems when the server goes down, e.g. loss of information, unable to process information • lack of personal contact, e.g. when using automated systems • not challenging the data produced through ICT, assuming it is correct • additional volume of information caused by increased speed of input/output **Topic A.2 Consider the factors that need to be considered when using ICT in the workplace:** • purpose, e.g. inform, persuade • audience, including internal and external, e.g. colleague, customer, client, public • need to meet legal requirements for the storage and use of data

Learning aims and unit content

The unit content gives the basis for the teaching, learning and assessment for each learning aim. Topic headings are given, where appropriate.

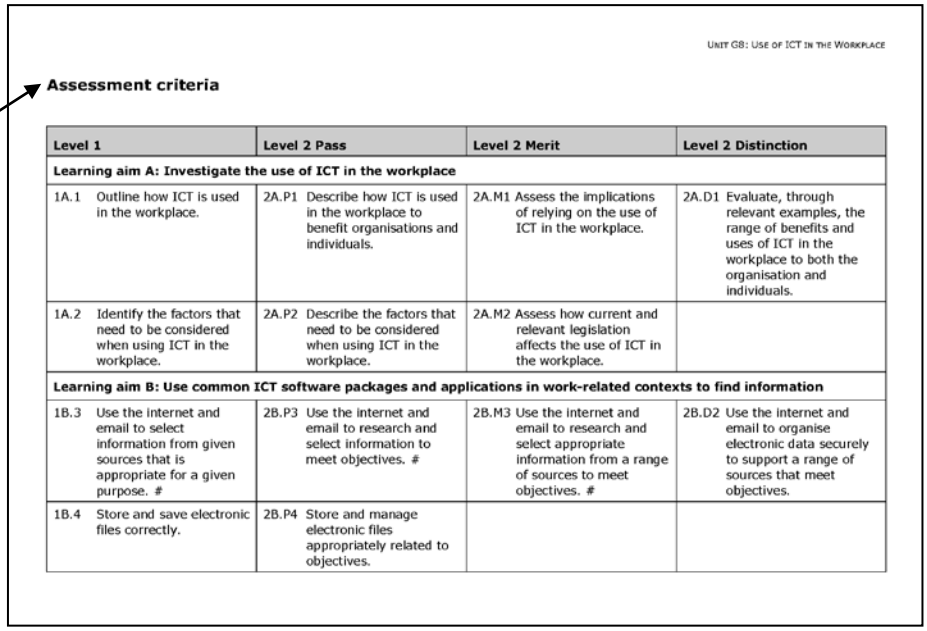
Content covers:

- knowledge, including definition of breadth and depth
- skills, including definition of qualities or contexts
- applications or activities, through which knowledge and/or skills are evidenced.

Content should normally be treated as compulsory for teaching the unit. Definition of content sometimes includes examples prefixed with 'e.g.'. These are provided as examples and centres may use all or some of these, or bring in additional material, as relevant.

Assessment criteria

The assessment criteria determine the minimum standard required by the learner to achieve the relevant grade. The learner must provide sufficient and valid evidence to achieve the grade.



UNIT G8: USE OF ICT IN THE WORKPLACE

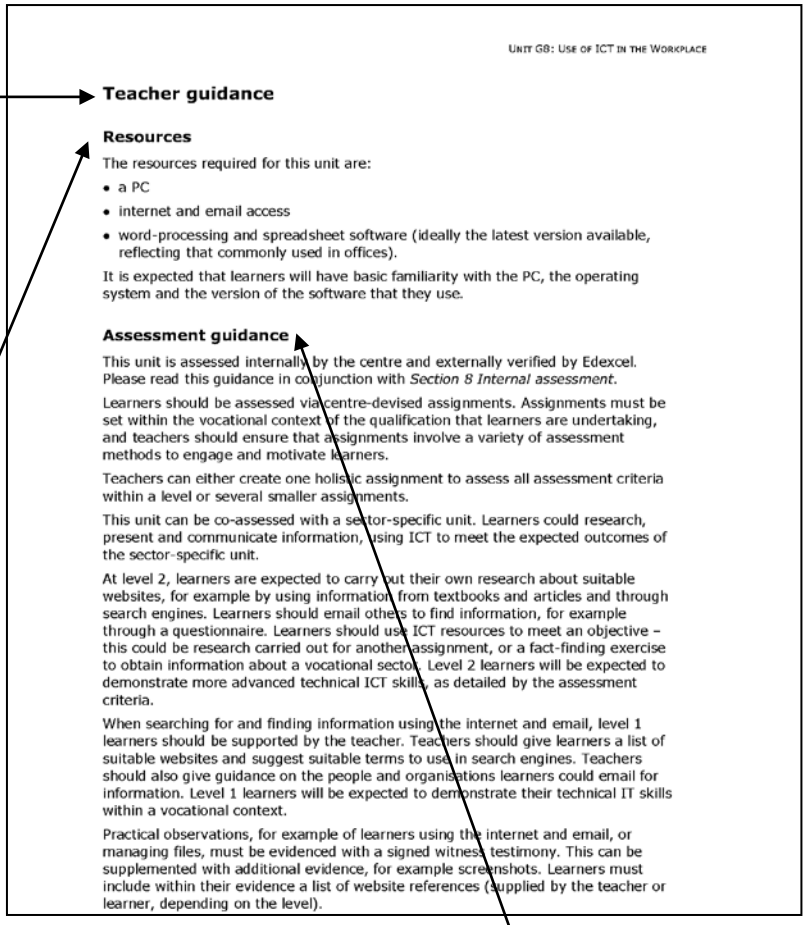
Assessment criteria

Level 1	Level 2 Pass	Level 2 Merit	Level 2 Distinction
Learning aim A: Investigate the use of ICT in the workplace			
1A.1 Outline how ICT is used in the workplace.	2A.P1 Describe how ICT is used in the workplace to benefit organisations and individuals.	2A.M1 Assess the implications of relying on the use of ICT in the workplace.	2A.D1 Evaluate, through relevant examples, the range of benefits and uses of ICT in the workplace to both the organisation and individuals.
1A.2 Identify the factors that need to be considered when using ICT in the workplace.	2A.P2 Describe the factors that need to be considered when using ICT in the workplace.	2A.M2 Assess how current and relevant legislation affects the use of ICT in the workplace.	
Learning aim B: Use common ICT software packages and applications in work-related contexts to find information			
1B.3 Use the internet and email to select information from given sources that is appropriate for a given purpose. #	2B.P3 Use the internet and email to research and select information to meet objectives. #	2B.M3 Use the internet and email to research and select appropriate information from a range of sources to meet objectives. #	2B.D2 Use the internet and email to organise electronic data securely to support a range of sources that meet objectives.
1B.4 Store and save electronic files correctly.	2B.P4 Store and manage electronic files appropriately related to objectives.		

Teacher guidance

While the main content of the unit is addressed to the learner, this section gives you additional guidance and amplification to aid your understanding and to ensure a consistent level of assessment.

Resources – identifies any special resources required for learners to show evidence of the assessment. Your centre must make sure that any requirements are in place when it seeks approval from Pearson to offer the qualification.



UNIT G8: USE OF ICT IN THE WORKPLACE

Teacher guidance

Resources

The resources required for this unit are:

- a PC
- internet and email access
- word-processing and spreadsheet software (ideally the latest version available, reflecting that commonly used in offices).

It is expected that learners will have basic familiarity with the PC, the operating system and the version of the software that they use.

Assessment guidance

This unit is assessed internally by the centre and externally verified by Edexcel. Please read this guidance in conjunction with *Section 8 Internal assessment*.

Learners should be assessed via centre-devised assignments. Assignments must be set within the vocational context of the qualification that learners are undertaking, and teachers should ensure that assignments involve a variety of assessment methods to engage and motivate learners.

Teachers can either create one holistic assignment to assess all assessment criteria within a level or several smaller assignments.

This unit can be co-assessed with a sector-specific unit. Learners could research, present and communicate information, using ICT to meet the expected outcomes of the sector-specific unit.

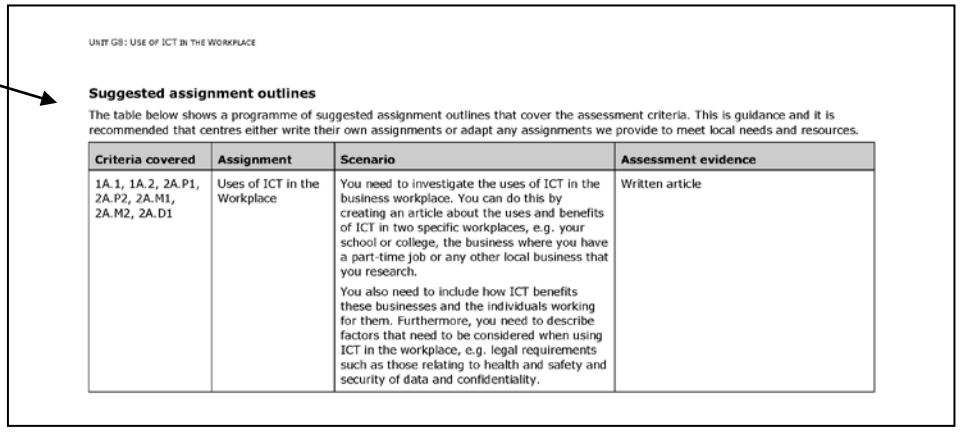
At level 2, learners are expected to carry out their own research about suitable websites, for example by using information from textbooks and articles and through search engines. Learners should email others to find information, for example through a questionnaire. Learners should use ICT resources to meet an objective – this could be research carried out for another assignment, or a fact-finding exercise to obtain information about a vocational sector. Level 2 learners will be expected to demonstrate more advanced technical ICT skills, as detailed by the assessment criteria.

When searching for and finding information using the internet and email, level 1 learners should be supported by the teacher. Teachers should give learners a list of suitable websites and suggest suitable terms to use in search engines. Teachers should also give guidance on the people and organisations learners could email for information. Level 1 learners will be expected to demonstrate their technical IT skills within a vocational context.

Practical observations, for example of learners using the internet and email, or managing files, must be evidenced with a signed witness testimony. This can be supplemented with additional evidence, for example screenshots. Learners must include within their evidence a list of website references (supplied by the teacher or learner, depending on the level).

Assessment guidance – gives examples of the quality of work needed to differentiate the standard of work submitted. It also offers suggestions for creative and innovative ways in which learners can produce evidence to meet the criteria. The guidance highlights approaches and strategies for developing appropriate evidence.

Suggested assignment outlines – gives examples of possible assignment ideas. These are not mandatory. Your centre is free to adapt them, or you can design your own assignment tasks.



UNIT G8: USE OF ICT IN THE WORKPLACE

Suggested assignment outlines

The table below shows a programme of suggested assignment outlines that cover the assessment criteria. This is guidance and it is recommended that centres either write their own assignments or adapt any assignments we provide to meet local needs and resources.

Criteria covered	Assignment	Scenario	Assessment evidence
1A.1, 1A.2, 2A.P1, 2A.P2, 2A.M1, 2A.M2, 2A.D1	Uses of ICT in the Workplace	You need to investigate the uses of ICT in the business workplace. You can do this by creating an article about the uses and benefits of ICT in two specific workplaces, e.g. your school or college, the business where you have a part-time job or any other local business that you research. You also need to include how ICT benefits these businesses and the individuals working for them. Furthermore, you need to describe factors that need to be considered when using ICT in the workplace, e.g. legal requirements such as those relating to health and safety and security of data and confidentiality.	Written article

8 Internal assessment

Language of assessment

Assessment of the internal and external units for this qualification will be available in English. All learner work must be in English. This qualification can also be made available through the medium of Welsh in which case learners may submit work in Welsh and/or English.

A learner taking the qualification may be assessed in British or Irish Sign Language where it is permitted for the purpose of reasonable adjustment.

Summary of internal assessment

For the Pearson BTEC Level 1/Level 2 First qualifications, the majority of the units are assessed through internal assessment, which means that you can deliver the programme in a way that suits your learners and relates to local need. The way in which you deliver the programme must also ensure that assessment is fair and that standards are nationally consistent over time.

To achieve this, it is important that you:

- plan the assessment of units to fit with delivery, allowing for the linkages between units
- write suitable assessments (for example, assignments, projects or case studies) or select assessments from available resources, adapting them as necessary
- plan the assessment for each unit in terms of when it will be authorised by the Lead Internal Verifier, when it will be used and assessed, and how long it will take, and how you will determine that learners are ready to begin an assessment
- ensure each assessment is fit for purpose, valid, will deliver reliable assessment outcomes across assessors, and is authorised before use
- provide all the preparation, feedback and support that learners need to undertake an assessment before they begin producing their evidence
- make careful and consistent assessment decisions based only on the defined assessment criteria and unit requirements
- validate and record assessment decisions carefully and completely
- work closely with Pearson to ensure that your implementation, delivery and assessment is consistent with national standards.

Assessment and verification roles

There are three key roles involved in implementing assessment processes in your school or college, namely:

- Lead Internal Verifier
- Internal Verifier – the need for an Internal Verifier or Internal Verifiers in addition to the Lead Internal Verifier is dependent on the size of the programme in terms of assessment locations, number of assessors and optional paths taken. Further guidance can be obtained from your Regional Quality Manager or Centre Quality Reviewer if you are unsure about the requirements for your centre
- assessor.

The Lead Internal Verifier must be registered with Pearson and is required to train and standardise assessors and Internal Verifiers using materials provided by Pearson that demonstrate the application of standards. In addition, the Lead Internal Verifier should provide general support. The Lead Internal Verifier:

- has overall responsibility for the programme assessment plan, including the duration of assessment and completion of verification
- can be responsible for more than one programme
- ensures that there are valid assessment instruments for each unit in the programme
- ensures that relevant assessment documentation is available and used for each unit
- is responsible for the standardisation of assessors and Internal Verifiers using Pearson-approved materials
- authorises individual assessments as fit for purpose
- checks samples of assessment decisions by individual assessors and Internal Verifiers to validate that standards are being correctly applied
- ensures the implementation of all general assessment policies developed by the centre for BTEC qualifications
- has responsibility for ensuring learner work is authenticated
- liaises with Pearson, including the Pearson Standards Verifier.

Internal Verifiers must oversee all assessment activity to make sure that individual assessors do not misinterpret the specification or undertake assessment that is not consistent with the national standard in respect of level, content or duration of assessment. The process for ensuring that assessment is being conducted correctly is called internal verification. Normally, a programme team will work together with individuals being both assessors and Internal Verifiers, with the team leader or programme manager often being the registered Lead Internal Verifier.

Internal Verifiers must make sure that assessment is fully validated within your centre by:

- checking every assessment instrument carefully and endorsing it before it is used
- ensuring that each learner is assessed carefully and thoroughly using only the relevant assessment criteria and associated guidance within the specification
- ensuring the decisions of every assessor for each unit at all grades and for all learners are in line with national standards.

Assessors make assessment decisions and must be standardised using Pearson-approved materials before making any assessment decisions. They are usually the teachers within your school or college, but the term ‘assessor’ refers to the specific responsibility for carrying out assessment and making sure that it is done in a way that is correct and consistent with national standards. Assessors may also draft or adapt internal assessment instruments.

You are required to keep records of assessment and have assessment authorised by Pearson. The main records are:

- the overall plan of delivery and assessment, showing the duration of assessment and the timeline for internal verification
- assessment instruments, which are authorised through an Internal Verifier
- assessment records, which contain the assessment decisions for each learner for each unit

- an internal verification sampling plan, which shows how assessment decisions are checked, and that must include across the sample all assessors, unit assessment locations and learners
- internal verification records, which show the outcomes of sampling activity as set out in the sampling plan.

Learner preparation

Internal assessment is the main form of assessment for this qualification, so preparing your learners for it is very important because they:

- must be prepared for and motivated to work consistently and independently to achieve the requirements of the qualification
- need to understand how they will be assessed and the importance of timescales and deadlines
- need to appreciate fully that all the work submitted for assessment must be their own.

You will need to provide learners with an induction and a guide or handbook to cover:

- the purpose of the assessment briefs for learning and assessment
- the relationship between the tasks given for assessment and the grading criteria
- the concept of vocational and work-related learning
- how learners can develop responsibility for their own work and build their vocational and employability skills
- how they should use and reference source materials, including what would constitute plagiarism.

Designing assessment instruments

An assessment instrument is any kind of activity or task that is developed for the sole purpose of assessing learning against the learning aims. When you develop assessment instruments you will often be planning them as a way to develop learners' skills and understanding. However, they must be fit for purpose as a tool to measure learning against the defined content and assessment criteria to ensure your final assessment decisions meet the national standard.

You should make sure that assessment tasks and activities enable learners to produce valid, sufficient, authentic and appropriate evidence that relates directly to the specified criteria within the context of the learning aims and unit content. You need to ensure that the generation of evidence is carefully monitored, controlled and produced in an appropriate timescale. This will help you to make sure that learners are achieving to the best of their ability and at the same time that the evidence is genuinely their own.

An assessment that is fit for purpose and suitably controlled is one in which:

- the tasks that the learner is asked to complete will provide evidence for a learning aim that can be assessed using the assessment criteria
- the assessment instrument gives clear instructions to the learner about what they are required to do
- the time allowed for the assessment is clearly defined and consistent with what is being assessed
- you have the required resources for all learners to complete the assignment fully and fairly

- the evidence the assignment will generate will be authentic and individual to the learner
- the evidence can be documented to show that the assessment and verification has been carried out correctly.

You may develop assessments that cover a whole unit, parts of a unit or several units, provided that all units and their associated learning aims are fully addressed through the programme overall. A learning aim **must** be covered completely in an assessment. Learning aim coverage must not be split between assignments. In some cases it may be appropriate to cover a learning aim with two tasks or sub-tasks within a single assignment. This must be done with care to ensure the evidence produced for each task can be judged against the full range of achievement available in the learning aim for each activity. This means it is not acceptable to have a task that contains a Pass level activity, then a subsequent task that targets a Merit or Distinction level activity. However, it is possible to have two tasks for different assessed activities, each of which stretch and challenge the learners to aim to produce evidence that can be judged against the full range of available criteria.

When you give an assessment to learners, it must include:

- a clear title and/or reference so that the learner knows which assessment it is
- the unit(s) and learning aim(s) being addressed
- a scenario, context, brief or application for the task
- task(s) that enable the generation of evidence that can be assessed against the assessment criteria
- details of the evidence that the learner must produce
- clear timings and deadlines for carrying out tasks and providing evidence.

Your assessment tasks should enable the evidence generated to be judged against the full range of assessment criteria; it is important the learners are given the opportunity for stretch and challenge.

The units include guidance on appropriate approaches to assessment. A central feature of vocational assessment is that it should be:

- current, i.e. it reflects the most recent developments and issues
- local, i.e. it reflects the employment context of your area
- flexible, i.e. it allows you as a centre to deliver the programme, making best use of the vocational resources that you have
- consistent with national standards, with regard to the level of demand.

Your centre should use the assessment guidance within units along with your local resource availability and guidance to develop appropriate assessments. It is acceptable to use and adapt resources to meet learner needs and the local employment context.

You need to make sure that the type of evidence generated fits with the unit requirement, that it is vocational in nature, and that the context in which the assessment is set is in line with unit assessment guidance and content. For many units, this will mean providing for the practical demonstration of skills. For many learning aims, you will be able to select an appropriate vocational format for evidence generation, such as:

- written reports, graphs, posters
- projects, project plans
- time-constrained practical assessments
- audio-visual recordings of portfolio, sketchbook, a working logbook, etc
- presentations.

Authenticity and authentication

You can accept only evidence for assessment that is authentic, i.e. that is the learner's own and that can be judged fully to see whether it meets the assessment criteria.

You should ensure that authenticity is considered when setting assignments. For example, ensuring that each learner has a different focus for research will reduce opportunities for copying or collaboration. On some occasions it will be useful to include supervised production of evidence. Where appropriate, practical activities or performance observed by the assessor should be included.

Learners must authenticate the evidence that they provide for assessment. They do this by signing a declaration stating that it is their own work when they submit it to certify:

- the evidence submitted for this assignment is the learner's own
- the learner has clearly referenced any sources used in the work
- they understand that false declaration is a form of malpractice.

Your assessors should assess only learner evidence that is authentic. If they find through the assessment process that some or all of the evidence is not authentic, they need to take appropriate action, including invoking malpractice policies as required.

It is important that all evidence can be validated through verification. This means that it must be capable of being reassessed in full by another person. When you are using practical and performance evidence, you need to think about how supporting evidence can be captured through using, for example, videos, recordings, photographs, handouts, task sheets, etc. This should be submitted as part of the learner's evidence.

The authentication of learner evidence is the responsibility of your centre. If during external sampling a Pearson Standards Verifier raises concerns about the authenticity of evidence, your centre will be required to investigate further. Depending on the outcomes, penalties may be applied. At the end of this section, you can find an example of a template that can be used to record the declaration of learners in relation to the authenticity of the evidence presented for assessment.

Applying criteria to internal assessments

Each unit and learning aim has specified assessment criteria. Your centre should use these criteria for assessing the quality of the evidence provided. This determines the grade awarded.

Unless specifically indicated by the assessment guidance, assessment criteria are not a set of sequential activities but a way of making a judgement. For example, if a Level 2 Pass specifies a 'description' and a Merit an 'analysis', these do not require two different activities but rather one activity through which some learners will provide only description evidence and others will also provide analysis evidence. The assessment criteria are hierarchical. A learner can achieve a Merit only if they provide sufficient evidence for the Level 2 Pass and Merit criteria. Similarly, a learner can achieve a Distinction only if they give sufficient evidence for the Level 2 Pass, Merit and Distinction criteria.

A final unit grade is awarded after all opportunities for achievement are given. A learner must achieve all the assessment criteria for that grade. Therefore:

- to achieve a Level 2 Distinction a learner must have satisfied all the Distinction criteria in a way that encompasses all the Level 2 Pass, Merit and Distinction criteria, providing evidence of performance of outstanding depth, quality or application
- to achieve a Level 2 Merit a learner must have satisfied all the Merit criteria in a way that encompasses all the Level 2 Pass and Merit criteria, providing performance of enhanced depth or quality
- to achieve a Level 2 Pass a learner must have satisfied all the Level 2 Pass criteria, showing breadth of coverage of the required unit content and having relevant knowledge, understanding and skills
- a learner can be awarded a Level 1 if the Level 1 criteria are fully met. A Level 1 criterion is not achieved through failure to meet the Level 2 Pass criteria.

A learner who does not achieve all the assessment criteria at Level 1 has not passed the unit and should be given a grade of U (Unclassified).

A learner must achieve all the defined learning aims to pass the internally assessed units. There is no compensation within the unit.

Assessment decisions

Final assessment is the culmination of the learning and assessment process. Learners should be given a full opportunity to show how they have achieved the learning aims covered by a final assessment. This is achieved by ensuring that learners have received all necessary learning, preparation and feedback on their performance and then confirming that they understand the requirements of an assessment, before any assessed activities begin.

There will then be a clear assessment outcome based on the defined assessment criteria. Your assessment plan will set a clear timeline for assessment decisions to be reached. Once an assessment has begun, learners must not be given feedback on progress towards criteria. After the final assignment is submitted, an assessment decision must be given.

An assessment decision:

- must be made with reference to the assessment criteria
- should record how it has been reached, indicating how or where criteria have been achieved
- may indicate why attainment against criteria has not been demonstrated
- must not provide feedback on how to improve evidence to meet higher criteria.

Your Internal Verifiers and assessors must work together to ensure that assessment decisions are reached promptly and validated before they are given to the learner.

Late submission

You should encourage learners to understand the importance of deadlines and of handing work in on time. For assessment purposes it is important that learners are assessed fairly and consistently according to the assessment plan that the Lead Internal Verifier has authorised and that some learners are not advantaged by having additional time to complete assignments. You are not required to accept for assessment work that was not completed by the date in the assessment plan.

Learners may be given authorised extensions for legitimate reasons, such as illness at the time of submission. If you accept a late completion by a learner, the evidence should be assessed normally, unless it is judged to not meet the requirements for authenticity. It is not appropriate, however, to give automatic downgrades on assessment decisions as 'punishment' for late submission.

Resubmission of improved evidence

Once an assessment decision is given to a learner, it is final in all cases except where the Lead Internal Verifier approves **one** opportunity to resubmit improved evidence.

The criteria used to authorise a resubmission opportunity are always:

- initial deadlines or agreed extensions have been met
- the tutor considers that the learner will be able to provide improved evidence without further guidance
- the evidence submitted for assessment has been authenticated by the learner and the assessor
- the original assessment can remain valid
- the original evidence can be extended and re-authenticated.

Your centre will need to provide a specific resubmission opportunity that is authorised by the Lead Internal Verifier. Any resubmission opportunity must have a deadline that is within 10 working days of the assessment decision being given to the learner, and within the same academic year. You should make arrangements for resubmitting the evidence for assessment in such a way that it does not adversely affect other assessments and does not give the learner an unfair advantage over other learners.

You need to consider how the further assessment opportunity ensures that assessment remains fit for purpose and in line with the original requirements; for example, you may opt for learners to improve their evidence under supervised conditions, even if this was not necessary for the original assessment, to ensure that plagiarism cannot take place. How you provide opportunities to improve and resubmit evidence for assessment needs to be fair to all learners. Care must be taken when setting assignments and at the point of final assessment to ensure that the original evidence for assessment can remain valid and can be extended. The learner must not have further guidance and support in producing further evidence. The Standards Verifier will want to include evidence that has been resubmitted as part of the sample they will review.

Appeals

Your centre must have a policy for dealing with appeals from learners. These appeals may relate to assessment decisions being incorrect or assessment not being conducted fairly. The first step in such a policy would be a consideration of the evidence by a Lead Internal Verifier or other member of the programme team. The assessment plan should allow time for potential appeals after assessment decisions have been given to learners.

If there is an appeal by a learner you must document the appeal and its resolution.

Dealing with malpractice

Your centre must have a policy for dealing with potential malpractice by learners. Your policy must follow the Pearson Assessment Malpractice policy. You must report serious malpractice to Pearson, particularly if any units have been subject to quality assurance or certification.

Reasonable adjustments to assessment

You are able to make adjustments to assessments to take account of the needs of individual learners in line with Pearson's Reasonable Adjustments and Special Considerations policy. In most instances this can be achieved simply by application of the policy, for example to extend time or adjust the format of evidence. We can advise you if you are uncertain as to whether an adjustment is fair and reasonable.

Special consideration

You must operate special consideration in line with Pearson's Reasonable Adjustments and Special Considerations policy. You can provide special consideration only in the time given for evidence to be provided or for the format of the assessment if it is equally valid. You may not substitute alternative forms of evidence to that required in a unit, or omit the application of any assessment criteria to judge attainment. Pearson can consider applications for special consideration in line with the policy.

(Exemplar for centres)

Learner Assessment Submission and Declaration

This sheet must be completed by the learner and provided for work submitted for assessment.

Learner name:	Assessor name:	
Date issued:	Completion date:	Submitted on:
Qualification:		
Assessment reference and title:		

Please list the evidence submitted for each task. Indicate the page numbers where the evidence can be found or describe the nature of the evidence (e.g. video, illustration).

Task ref.	Evidence submitted	Page numbers or description
Comments for note by the assessor:		

Learner declaration

I certify that the work submitted for this assignment is my own. I have clearly referenced any sources used in the work. I understand that false declaration is a form of malpractice.

Learner signature: Date:

_____

9 External assessment

Externally assessed units have the same grades as internally assessed units:

- Level 2 – Pass, Merit, Distinction
- Level 1
- Unclassified.

The table below shows the type of external assessment and assessment availability for this qualification.

Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science

Unit 1: Principles of Science	
Type of external assessment	This unit is assessed externally using a paper-based exam marked by Pearson.
Length of assessment	The external assessment will be 60 minutes. The assessment must be taken by the learner under examination conditions.
Number of marks	54
Assessment availability	March and June
First assessment availability	June 2013

Your centre needs to make sure that learners are:

- fully prepared to sit the external assessment
- entered for assessments at appropriate times, with due regard for resit opportunities as necessary.

Sample assessment materials will be available to help centres prepare learners for assessment. Specific arrangements for external assessment are available before the start of each academic year on our website qualifications.pearson.com.

Grade descriptors for the internal and external units

Internal units

Each internally assessed unit has specific assessment criteria that your centre must use to judge learner work in order to arrive at a grading decision for the unit as a whole. For internally assessed units, the assessor judges the evidence that the learner has presented to determine whether it meets all the relevant criteria, and then awards a grade at the appropriate level.

The criteria are arrived at with reference to the following grading domains:

- applying knowledge and understanding in vocational and realistic contexts, with reference to relevant concepts and processes, to achieve tasks, produce outcomes and review the success of outcomes
- developing and applying practical and technical skills, acting with increasing independence to select and apply skills through processes and with effective use of resources to achieve, explain and review the success of intended outcomes
- developing generic skills for work through management of self, working in a team and the use of a variety of relevant communication and presentation skills, and the development of critical thinking skills relevant to vocational contexts.

The externally assessed units are assessed using a marks-based scheme.
The following criteria are used in the setting and awarding of these units.

External units

The externally assessed units are assessed using a marks-based scheme. For each external assessment, grade boundaries, based on learner performance, will be set by the awarding organisation.

The following criteria are used in the setting and awarding of the external unit.

Level 2 Pass

Learners will be able to recall, select and apply knowledge and understanding of scientific processes. They will be able to apply key terms, processes and technologies and interpret information in order to select and apply knowledge of scientific processes. They will be able to use given information and apply appropriate mathematical and technical skills in context. Learners will be able to relate scientific knowledge to vocational and realistic situations making some valid decisions. They will be able to use correct scientific terminology and concepts in given situations.

Level 2 Distinction

Learners will be able to synthesise scientific knowledge and processes showing deeper understanding of how these apply in context. They will show depth of knowledge and development of their understanding to make effective judgements based on scientific analysis of given information. Learners will be able to select relevant information and apply appropriate mathematical and technical skills to justify decisions in context. They will be able to use scientific knowledge in vocational and realistic situations, making sound judgements on valid applications and impact. They will be able to use scientific terminology and concepts, communicating consistently and effectively in given situations.

10 Awarding and reporting for the qualification

The awarding and certification of this qualification will comply with the requirements of the Office of Qualifications and Examinations Regulation (Ofqual).

Calculation of the qualification grade

This qualification is a level 2 qualification, and the certification may show a grade of Level 2 Pass, Level 2 Merit, Level 2 Distinction or Level 2 Distinction*. If these are not achieved a Level 1 or Unclassified grade may be awarded.

Each individual unit will be awarded a grade of Level 2 Pass, Merit or Distinction, Level 1 or Unclassified. Distinction* is not available at unit level.

Award of Distinction* (D*)

D* is an aggregated grade for the qualification, based on the learner's overall performance. In order to achieve this grade, learners will have to demonstrate a strong performance across the qualification as a whole.

To achieve a level 2 qualification learners must:

- complete and report an outcome for all units within the permitted combination (NB Unclassified is a permitted unit outcome)
- achieve the minimum number of points at a grade threshold from the permitted combination. See the Calculation of qualification grade table.

Learners who do not achieve a level 2 may be entitled to achieve a level 1 where they:

- complete and report an outcome for all units within the permitted combination (NB Unclassified is a permitted unit outcome)
- achieve the minimum number of points for a level 1. See the Calculation of qualification grade table.

Points available for unit size and grades

The table below shows the **number of points scored per 10 guided learning hours** at each grade.

Points per grade per 10 guided learning hours				
Unclassified	**Level 1**	**Level 2 Pass**	**Level 2 Merit**	**Level 2 Distinction**
0	2	4	6	8

Pearson will automatically calculate the qualification grade for your learners when your learner unit grades are submitted. Learners will be awarded qualification grades for achieving the sufficient number of points within the ranges shown in the Calculation of qualification grade table.

Example:

A learner achieves a unit at Level 2 Pass grade. The unit size is 30 guided learning hours (GLH). Therefore they gain 12 points for that unit, i.e. 4 points for each 10 GLH, therefore 12 points for 30 GLH.

Calculation of qualification grade

Award (120 GLH)	
Grade	**Minimum points required**
U	0
Level 1	24
Level 2 Pass	48
Level 2 Merit	66
Level 2 Distinction	84
Level 2 Distinction*	90

Calculation of qualification grade above pass grade

Example 1: Achievement of an Award with a Level 2 Merit grade

	GLH	Weighting (GLH/10)	Grade	Grade points	Points per unit (weighting × grade points)
Unit 1	30	3	Level 2 Merit	6	18
Unit 2	30	3	Level 2 Pass	4	12
Unit 3	30	3	Level 2 Merit	6	18
Unit 4	30	3	Level 2 Merit	6	18
Qualification grade totals	**120**	**12**	**Level 2 Merit**		**66**

The learner has sufficient points for a Level 2 Merit grade.

Example 2: Achievement of an Award with a Level 2 Pass grade

	GLH	Weighting (GLH/10)	Grade	Grade points	Points per unit (weighting × grade points)
Unit 1	30	3	Level 2 Merit	6	18
Unit 2	30	3	Level 1	2	6
Unit 3	30	3	Level 2 Merit	6	18
Unit 4	30	3	Level 1	2	6
Qualification grade totals	**120**	**12**	**Level 2 Pass**		**48**

The learner has sufficient points for a Level 2 Pass grade.

Example 3: Achievement of an Award with a Level 1 grade

	GLH	Weighting (GLH / 10)	Grade	Grade points	Points per unit (weighting × grade points)
Unit 1	30	3	Level 1	2	6
Unit 2	30	3	Level 2 Pass	4	12
Unit 3	30	3	Level 2 Pass	4	12
Unit 4	30	3	Level 1	2	6
Qualification grade totals	**120**	**12**	**Level 1**		**36**

The learner has sufficient points for a Level 1 grade.

Example 4: Achievement of an Award with an Unclassified grade

	GLH	Weighting (GLH / 10)	Grade	Grade points	Points per unit (weighting × grade points)
Unit 1	30	3	Level 1	2	6
Unit 2	30	3	Level 1	2	6
Unit 3	30	3	Level 1	2	6
Unit 4	30	3	Unclassified	0	0
Qualification grade totals	**120**	**12**	Unclassified		**18**

The learner has insufficient points for a Level 1 grade, so achieves an Unclassified grade.

11 Quality assurance of centres

Pearson will produce on an annual basis the *BTEC Quality Assurance Handbook*, which will contain detailed guidance on the quality processes required to underpin robust assessment and internal verification.

The key principles of quality assurance are that:

- a centre delivering BTEC programmes must be an approved centre, and must have approval for the programmes or groups of programmes that it is delivering
- the centre agrees, as part of gaining approval, to abide by specific terms and conditions around the effective delivery and quality assurance of assessment; it must abide by these conditions throughout the period of delivery
- Pearson makes available to approved centres a range of materials and opportunities, through online standardisation, intended to exemplify the processes required for effective assessment, and examples of effective standards. Approved centres must use the materials and services to ensure that all staff delivering BTEC qualifications keep up to date with the guidance on assessment
- an approved centre must follow agreed protocols for standardisation of assessors and verifiers, for the planning, monitoring and recording of assessment processes, and for dealing with special circumstances, appeals and malpractice.

The approach of quality-assured assessment is through a partnership between an approved centre and Pearson. We will make sure that each centre follows best practice and employs appropriate technology to support quality-assurance processes, where practicable. We work to support centres and seek to make sure that our quality-assurance processes do not place undue bureaucratic processes on centres.

We monitor and support centres in the effective operation of assessment and quality assurance. The methods we use to do this for BTEC First programmes include:

- making sure that all centres complete appropriate declarations at the time of approval
- undertaking approval visits to centres
- making sure that centres have effective teams of assessors and verifiers who are trained to undertake assessment
- assessment sampling and verification, through requested samples of assessments, completed assessed learner work and associated documentation
- an overarching review and assessment of a centre's strategy for assessing and quality assuring its BTEC programmes.

An approved centre must make certification claims only when authorised by us and strictly in accordance with requirements for reporting.

Centres that do not fully address and maintain rigorous approaches to quality assurance cannot seek certification for individual programmes or for all BTEC First programmes. Centres that do not comply with remedial action plans may have their approval to deliver qualifications removed.

12 Further information and useful publications

For further information about the qualification featured in this specification, or other Pearson qualifications, please call Customer Services on 0844 576 0026 (calls may be monitored for quality and training purposes) or visit our website qualifications.pearson.com.

Related information and publications include:

- *Equality Policy*
- *Information Manual* (updated annually)
- *Access arrangements, reasonable adjustments and special considerations*
- *Quality Assurance Handbook* (updated annually).
  - Publications on the quality assurance of BTEC qualifications are on our website at qualifications.pearson.com

Additional documentation

Additional materials include:

- Sample Assessment Material (for the external unit)
- a guide to *Getting Started with BTEC*
- guides to our support for planning, delivery and assessment (including sample assignment briefs).

Visit www.btec.co.uk/2012 for more information.

Additional resources

If you need to source further learning and teaching material to support planning and delivery for your learners, there is a wide range of BTEC resources available to you.

Any publisher can seek endorsement for their resources, and, if they are successful, we will list their BTEC resources on our website qualifications.pearson.com.

13 Professional development and support

Pearson supports UK and international customers with training related to BTEC qualifications. This support is available through a choice of training options offered in our published training directory, or through customised training at your centre.

The support we offer focuses on a range of issues including:

- planning for the delivery of a new programme
- planning for assessment and grading
- developing effective assignments
- building your team and teamwork skills
- developing learner-centred learning and teaching approaches
- building functional skills into your programme
- building in effective and efficient quality-assurance systems.

The national programme of training we offer is on our website at qualifications.pearson.com. You can request customised training through the website, or you can contact one of our advisors in the Training from Pearson team via Customer Services to discuss your training needs.

BTEC training and support for the lifetime of the qualification

Training and networks: our training programme ranges from free introductory events through sector-specific opportunities to detailed training on all aspects of delivery, assignments and assessment. In addition, we have designed our new network events programme to allow you to share your experiences, ideas and best practice with other BTEC colleagues in your region. Sign up to the training you need at: www.btec.co.uk/training

Regional support: our team of Curriculum Development Managers and Curriculum Support Consultants, based around the country, are responsible for providing advice and support in centres. They can help you with planning and curriculum developments. Call **0844 576 0027** to contact the curriculum team for your centre.

Your BTEC Support team

Whether you want to talk to a sector specialist, browse online or submit your query for an individual response, there is someone in our BTEC Support team to help you whenever – and however – you need, with:

- Welcome Packs for new BTEC centres: if you are delivering BTEC for the first time, we will send you a sector-specific Welcome Pack designed to help you get started with the new Pearson BTEC Level 1/Level 2 First Award
- Subject Advisors: find out more about our subject advisor team – immediate, reliable support from a fellow subject expert – at: qualifications.pearson.com/subjectadvisors
- BTEC Hotline: call the BTEC Hotline on 0844 576 0026 with your query

Units

Unit 1: Principles of Science

Level: **1 and 2**

Unit type: **Mandatory**

Guided learning hours: **30**

Assessment type: **External**

Unit introduction

It is important that science technicians and scientists are able to use and apply fundamental core concepts to work efficiently and effectively in science organisations and other organisations that use science.

It is essential, for example, that biologists working in health-related science organisations have knowledge of cell structures and their function, tissues and organ systems, and the roles of the nervous and endocrine systems. Biologists working in horticulture will need knowledge of plant cells and the function of plant organs, and those working in forensic science will require knowledge of DNA.

In the chemical industry, science employees need to have knowledge of atomic structure, elements in the periodic table and chemical compounds and need to be able to use and apply this knowledge to chemical reactions involved in the manufacture of useful products. Knowledge of acids, alkalis and pH is essential for people working in soil science, environmental science and cosmetic science.

Science employees working in organisations involving energy will need knowledge of the different forms of energy, energy stores, energy transformations and alternative energy sources. Physicists working for the National Grid will need knowledge of energy transfers, energy transfer measurement and energy efficiency. Scientists working in hospital scanning departments will need knowledge of the dangers and uses of X-rays and other features of the electromagnetic spectrum.

The aim of this unit is to study fundamental core science concepts in biology, chemistry and physics. The assessment for this unit focuses on your understanding and application of these concepts, and so will not be vocational in context. A strong grasp of these concepts will enable you to use and apply this knowledge and understanding in vocational contexts when studying other units within this specification.

Learning aims

In this unit you will:

A explore cells, organs and genes

B explore the roles of the nervous and endocrine systems in homeostasis and communication

C explore atomic structure and the periodic table

D explore substances and chemical reactions

E explore the importance of energy stores, energy transfers and energy transformations

F explore the properties and applications of waves in the electromagnetic spectrum.

You will be asked to apply knowledge and understanding of these learning aims in familiar and unfamiliar contexts to solve mathematical and non-mathematical problems.

Learning aims and unit content

What needs to be learnt
Learning aim A: Explore cells, organs and genes
A.1 The basic structure, function and adaptations of the following eukaryotic cells: a. motor and sensory neurones b. red blood cell c. white blood cell d. egg cell e. sperm cell f. root hair cell g. xylem and phloem cells h. guard cell.
A.2 The function of the following components of eukaryotic cells: a. nucleus – contains genetic information that controls the activities of the cell b. cytoplasm – where most chemical reactions take place c. cell membrane – allows entry and exit of substances d. chloroplasts – the sites of photosynthesis e. cell wall – provides structural support f. vacuole – contains cell sap and provides extra support for the cell g. mitochondria – the sites of respiration.
A.3 Cells form tissues, tissues form organs and organs work together to form organ systems, as illustrated by the cardiovascular system (it is not necessary to learn the detail of each organ in this system).
A.4 The functions of the following plant organs: a. roots – take in water from the soil and provide anchorage b. xylem – carries water and mineral salts c. phloem – carries glucose d. leaf – where photosynthesis takes place.
A.5 Loss of water vapour from the leaves drives transpiration.
A.6 DNA is a double helix containing a sequence of complementary base pairs: a. adenine pairs with thymine b. guanine pairs with cytosine.
A.7 Chromosomes, in the nucleus, are made up of DNA, and sections of DNA represent genes which give instructions for individual characteristics.
A.8 Alleles are different forms of the same gene that give rise to heterozygous and homozygous genotypes.
A.9 Monohybrid inheritance using Punnett squares and genetic diagrams.
A.10 Pedigree analysis using homozygous and heterozygous individuals.
A.11 Determination of genotypes and phenotypes of offspring from genetic diagrams and pedigree analysis.
continued

What needs to be learnt	
A.12	The probability, percentage or ratio of offspring displaying particular inherited characteristics from genetic crosses.
A.13	Gene mutations occur when the base sequence on a DNA molecule is changed: a. genetic mutations can change the characteristics of organisms b. genetic mutations can be beneficial or harmful to organisms.
Learning aim B: Explore the roles of the nervous and endocrine systems in homeostasis and communication	
B.1	Homeostasis is the maintenance of a constant internal environment that is controlled by nervous and hormonal communication.
B.2	The structure of the nervous system is made up of the central nervous system (CNS) (brain and spinal cord) and the peripheral nervous system (PNS) (sensory and motor neurones). The PNS transmits electrical impulses to and from the CNS.
B.3	The difference between involuntary and voluntary responses.
B.4	The transmission of electrical impulses from receptor to effector and the role of chemical transmission across synapses.
B.5	The components of a simple reflex arc and its role in protecting the body from harm.
B.6	The endocrine system consists of glands that release hormones into the blood stream, which travel through the blood to target organs.
B.7	The differences in communication between the endocrine and nervous systems: a. speed of communication b. method of transport or transmission c. duration of response.
B.8	Blood glucose concentration is regulated by the endocrine system using insulin and glucagon (insulin lowers blood glucose concentrations and glucagon raises it).
B.9	The process for body temperature regulation by the nervous system using the following mechanisms: a. sweating b. shivering c. raising/lowering of body hair d. vasoconstriction and vasodilation.

What needs to be learnt	
Learning aim C: Explore atomic structure and the periodic table	
C.1	Elements as metals or non-metals according to their position in the periodic table.
C.2	The structure of the atom as a nucleus containing protons and neutrons, surrounded by electrons in shells (energy levels).
C.3	The nucleus of an atom is very small compared to the overall size of the atom.
C.4	Atoms of a given element have the same number of protons in the nucleus and this number is unique to that element.
C.5	The meaning of the terms 'atomic number', 'mass number' and 'relative atomic mass'.
C.6	The relative charge and relative mass of a proton, a neutron and an electron.
C.7	Atoms contain equal numbers of protons and electrons.
C.8	Elements are arranged in the periodic table in order of increasing atomic number, in rows called periods. Elements with similar properties are placed in the same vertical column – these columns are called groups.
C.9	Definition of an isotope of an element, as having the same number of protons but a different number of neutrons.
C.10	The existence of isotopes means that some relative atomic masses are not whole numbers.
C.11	The relative atomic mass of an element from the relative masses and abundances of its isotopes.
C.12	Rules about the filling of electron shells (energy levels) to predict the electronic configuration of the first 20 elements in the periodic table as diagrams and in the form 2.8.1.
C.13	The connection between the number of outer electrons and the position of an element in the periodic table.

What needs to be learnt	
Learning aim D: Explore substances and chemical reactions	
D.1	Use the periodic table to recognise elements and formulae of simple compounds.
D.2	Definitions of elements, compounds, mixtures, molecules (molecular elements).
D.3	Word equations for reactions in this unit.
D.4	Simple balanced chemical equations for reactions in this unit.
D.5	Chemicals react to form products with different properties, including acids, alkalis and salts.
D.6	Definition of: a. acids b. bases c. alkalis as a subset of bases which are soluble in water.
D.7	Neutralisation reactions using hydrochloric acid, nitric acid and sulfuric acid, with a metal oxide (copper oxide or zinc oxide) and sodium hydroxide.
D.8	The reactions of hydrochloric acid and sulfuric acid with metals (not group 1 metals).
D.9	The reactions of hydrochloric acid, sulfuric acid and nitric acid with sodium carbonate, copper carbonate and calcium carbonate.
D.10	The chemical tests for hydrogen and carbon dioxide.
D.11	pH tests using universal indicator and litmus.
D.12	Hazard symbols for the chemicals used in this learning aim.
D.13	Applications of neutralisation reactions: a. indigestion remedies (safe dose, chemicals used) b. reducing acidity of soils c. reducing acidity of lakes, caused by acid rain.
D.14	Formulae of all reagents named in this learning aim.

What needs to be learnt

Learning aim E: Explore the importance of energy stores, energy transfers and energy transformations

E.1 Forms of energy and their uses:

a. thermal
b. electrical
c. light
d. sound
e. mechanical (kinetic and potential)
f. nuclear.

E.2 Energy stores and their uses:

a. chemical
b. kinetic (in a moving object)
c. gravitational potential (due to the position of an object in a gravitational field)
d. elastic potential (in a stretched or compressed spring)
e. thermal (in a warm object)
f. nuclear.

E.3 Energy transfers (from one place to another):

a. mechanically (when a force moves through a distance)
b. electrically (electrical devices)
c. by conduction (temperature differences)
d. by convection (currents in a fluid)
e. by radiation (infrared and sound).

E.4 Energy transfer measurement:

a. joule (J) as the unit of energy
b. principle of conservation of energy
c. diagrams to represent energy transfers and energy dissipation
d. watt (W) as the unit of power
e. power calculations using:

$$\text{power (watts)} = \frac{\text{energy (joules)}}{\text{time (secs)}}$$

f. cost of electricity per unit (kWhr).

E.5 Efficiency of energy transfers and transformations:

a. efficiency as the proportion of energy transferred to useful forms
b. calculations involving efficiency using:

$$\text{efficiency} = \frac{\text{useful energy}}{\text{total energy supplied}} \text{ X } 100\%$$

E.6 Sources and storage of energy:

a. renewable (solar, wind, biofuels, hydroelectric, wave, tidal, geothermal)
b. non-renewable (fossil fuels, nuclear)
c. using energy stores effectively
d. storage of energy using batteries and fuel cells.

What needs to be learnt
Learning aim F: Explore the properties and applications of waves in the electromagnetic spectrum
F.1 Wave characteristics: a. amplitude (m) b. frequency (Hz) c. wavelength (m) d. wave speed (m/s). F.2 Wave calculations: a. using wave speed (m/s) = wavelength (m) x frequency (Hz) b. using values expressed in standard form. F.3 The electromagnetic (e.m.) spectrum: a. radio waves, microwaves, infrared, visible (including the colours of the visible spectrum), ultraviolet, X-rays and gamma rays b. the e.m. spectrum is continuous from radio waves to gamma rays, grouped in order of wavelength or frequency c. each group has a range of wavelengths with different uses and dangers. F.4 Uses of electromagnetic radiation in transferring energy: a. radio waves (broadcasting and satellite transmissions) b. microwaves (cooking, satellite transmissions, communications and weather forecasting) c. infrared (cooking, thermal imaging, optical fibres, television remote controls and security systems) d. visible light (vision, photography and illumination) e. ultraviolet (fluorescent lamps, detecting forged bank notes and disinfecting water) f. X-rays (observing the internal structure of objects and medical X-rays) g. gamma rays (sterilising food and medical equipment, and the detection of cancer and its treatment). F.5 Harmful effects of excessive exposure to electromagnetic radiation: a. microwaves (internal heating of body cells) b. infrared (skin burns) c. ultraviolet (damage to surface cells and eyes, leading to skin cancer and eye conditions) d. X-rays and gamma rays (mutation or damage to cells in the body).

Teacher guidance

Resources

There are no special resources needed for this unit.

Assessment guidance

This unit is assessed externally using a paper-based exam marked by Pearson.

Examination format

The learner will complete a 60-minute examination with 54 marks. The paper will consist of three sections. Section A will be biology, Section B will be chemistry and Section C will be physics. Each section will be worth 18 marks.

The learner will need to demonstrate knowledge and understanding, and the application of this knowledge.

Unit 2: Chemistry and Our Earth

Level: **1 and 2**

Unit type: **Mandatory**

Guided learning hours: **30**

Assessment type: **Internal**

Unit introduction

A knowledge and understanding of the properties of chemical substances is vital for making certain scientific decisions. For example, this knowledge and understanding would be applied when deciding which starting materials to use when carrying out chemical reactions to manufacture products such as pharmaceuticals, computer-chip technology materials and food products.

You will cover the properties of elements from groups 1 and 7 in the periodic table, where some elements, like sodium, are very reactive metals, while others, like chlorine, are very reactive non-metals. Other elements, like helium, are very unreactive – helium's properties make it suitable for use in balloons and in the gas mixture for diving tanks. This is extended further as you study the structure of elements, and how they bond together to form molecules, which are covalently or ionically bonded. You will also look at how the physical and chemical properties of chemical substances are influenced by their structure and bonding.

Industrial processes need to take into account the rate at which a chemical reaction takes place. Reactions have to be slow enough to be safe but fast enough to allow the chemicals to be made profitably. You will study the factors that affect the rates of chemical reactions and the reaction conditions that optimise their effectiveness in industry.

You will also study how the Earth's natural activities, and the use of naturally occurring materials as starting materials in industrial processes, have an impact on the Earth and the environment. This is extended to studying sustainable development issues, with regard to human activities and possible solutions to reduce the amount of fossil fuels used in domestic and industrial situations.

The aim of this unit is to use and develop the knowledge that you have learnt in Unit 1 using locally relevant industrial and related contexts. These contexts might include the role of environmental science in best industrial practice and maximising the yield of industrial reactions.

Learning aims

In this unit you will:

A investigate chemical reactivity and bonding

B investigate how the uses of chemical substances depend on their chemical and physical properties

C investigate the factors involved in the rate of chemical reactions

D understand the factors that are affecting the Earth and its environment.

Learning aims and unit content

What needs to be learnt
Learning aim A: Investigate chemical reactivity and bonding
A.1 Chemical and physical properties of groups 1 and 7 of the periodic table: a. trends in physical properties of groups 1 and 7 (appearance, melting point, boiling point, electrical conductivity) b. reactivity with water for group 1 c. displacement reactions for group 7 d. trends in chemical properties in group 1 and group 7 – relationship with electronic configuration. A.2 Bonding and structure: a. formulae of molecules (in A.2b and A.2c) b. covalent bonding (hydrogen, chlorine, carbon dioxide, methane, water, oxygen) c. ionic bonding (sodium chloride, magnesium oxide, magnesium chloride) d. properties of simple covalent, giant covalent and ionic materials.
Learning aim B: Investigate how the uses of chemical substances depend on their chemical and physical properties
B.1 Use of chemicals based on their physical properties: a. electrical conductivity b. thermal conductivity c. melting and boiling points d. solubility in different solvents e. viscosity. B.2 Use of chemicals based on their chemical properties: a. sodium azide in airbags b. argon in welding c. silicon in computer–chip technology d. carbon dioxide in fire extinguishers.

What needs to be learnt
Learning aim C: Investigate the factors involved in the rate of chemical reactions
C.1 Equations: a. word equations b. simple balanced equations (including state symbols: (s), (l), (g), (aq)) c. recognise reactants and products in a reaction (displacement, combustion, neutralisation reactions) d. reversible and irreversible chemical change. C.2 Reaction rates: a. effect of catalysts (lowering the energy needed for a reaction to occur), surface area, concentration and temperature on rate of reaction b. use of reaction rate graphs c. collision theory. C.3 Industrial processes: a. the concept of yield (mass of product obtained) and that the actual yield is less than the theoretical yield b. altering rates of reaction c. atom economy.
Learning aim D: Understand the factors that are affecting the Earth and its environment
D.1 Natural activity factors (tectonic plates and volcanic eruptions) influencing: a. the Earth's crust b. the evolution of the atmosphere and oceans. D.2 Human activity factors: a. obtaining materials from the sea, land and air, e.g. coal, natural gas, oil, metal ores, salt, nitrogen, oxygen b. production of useful materials from their natural sources c. effects on the environment (local and global effects) d. effects of chemical processing (energy factors, health and safety, disposal). D.3 Sustainable development issues: a. human choices (recycling, use of fossil fuels versus nuclear fission fuels) b. human solutions (renewable energy, biofuels (ethanol), nuclear fusion).

Assessment criteria

Level 1	Level 2 Pass	Level 2 Merit	Level 2 Distinction
Learning aim A: Investigate chemical reactivity and bonding			
1A.1 Classify group 1 and 7 elements based on their physical properties.	2A.P1 Describe the physical and chemical properties of group 1 and 7 elements.	2A.M1 Describe trends in the physical and chemical properties of group 1 and 7 elements.	2A.D1 Explain the trends in chemical properties of group 1 and 7 elements in terms of electronic structure.
1A.2 Describe properties of ionic and covalent substances.	2A.P2 Compare properties of ionic and covalent substances.	2A.M2 Explain the properties of ionic and covalent substances.	2A.D2 Relate applications of compounds to their properties and to their bonding and structure.
1A.3 Classify substances as ionic or covalent.	2A.P3 Draw dot-and-cross diagrams of simple ionic and covalent substances.	2A.M3 Describe the formation of ionic and covalent substances.	
Learning aim B: Investigate how uses of chemical substances depend on their chemical and physical properties			
1B.4 Describe physical properties of chemical substances.	2B.P4 Describe how chemical substances are used based on their physical properties.	2B.M4 Explain how physical and chemical properties of chemical substances make them suitable for their uses.	2B.D3 Assess the suitability of different types of substance for a specified use.
1B.5 Describe chemical properties of chemical substances.	2B.P5 Describe how chemical substances are used based on their chemical properties.		

Level 1	Level 2 Pass	Level 2 Merit	Level 2 Distinction
Learning aim C: Investigate the factors involved in the rate of chemical reactions			
1C.6 Identify the factors that can affect the rates of chemical reactions.	2C.P6 Describe the factors that can affect the rates of chemical reactions.	2C.M5 Explain how different factors affect the rate of industrial reactions.	2C.D4 Analyse how different factors affect the rate and yield of an industrial reaction.
1C.7 Identify reactants and products, including state symbols in chemical equations, and whether reactions are reversible or irreversible.	2C.P7 Identify the number and types of atoms in balanced chemical equations.*	2C.M6 Explain the terms 'yield' and 'atom economy' in relation to specific chemical reactions.	
Learning aim D: Understand the factors that are affecting the Earth and its environment			
1D.8 Identify the human activities that affect the Earth and its environment.	2D.P8 Describe the human activities that affect the Earth and its environment.	2D.M7 Discuss the extent to which human activity has changed the environment, in comparison to natural activity.	2D.D5 Evaluate possible solutions to changes in the environment, occurring from natural or human activity.
1D.9 Identify natural factors that have changed the surface and atmosphere of the Earth.	2D.P9 Describe natural factors that have changed the surface and atmosphere of the Earth.		

*Opportunity to assess mathematical skills

#Opportunity to assess English skills

Teacher guidance

Resources

There are no special resources needed for this unit.

Assessment guidance

This unit is assessed internally by the centre and externally verified by Pearson.

Please read this guidance in conjunction with S*ection 8 Internal assessment*.

The contents of this unit should be approached from a practical point of view as far as possible, e.g. through scientific investigative assignments. Industrial and related contexts for assessment should be locally relevant where possible and could include:

- for learning aims A and B, choices of materials for industrial applications based on their chemical and physical properties
- for learning aim C, approaches that can be used to improve the effectiveness of industrial reactions
- for learning aim D, investigating the mitigation of the local or global environmental impact of a process.

Level 1 exemplifies partial achievement within a level 2 learning aim.

Learning aim A: **Investigate chemical reactivity and bonding**

For 1A.1, learners must classify and categorise at least two elements from group 1 and at least two elements from group 7 based on their physical properties (e.g. boiling point, melting point, electrical conductivity, thermal conductivity, solubility in water and non-polar solvents, viscosity).

For 2A.P1, learners must build on their evidence for 1A.1 by describing the physical and chemical properties of the group 1 and 7 elements.

For 2A.M1, learners must describe one physical trend and one chemical trend for each group. For example, learners could describe the change in boiling point and displacement reactions for group 7 elements, and the change in melting point and chemical reactivity of group 1 elements with water.

For 2A.D1, learners should explain the trend in chemical properties that they have described for 2A.M1 using their understanding of electronic structure.

For 1A.2, learners must describe four typical properties of ionic substances and four typical properties of covalent substances.

For 2A.P2, learners should build on their evidence for 1A.2 by comparing the properties identified.

For 2A.M2, learners must explain the properties identified in 1A.2 and 2A.P2 in terms of the bonding and structure of ionic and covalent substances.

For 1A.3, from data provided or through practical investigation, learners must classify at least six different substances as being either covalent or ionic in nature.

For 2A.P3, learners must draw dot-and-cross diagrams for all substances listed in the unit content for learning aim A, topics A.2b and A.2c as a minimum.

For 2A.M3, learners could use their diagrams for 2A.P3 to describe how ions, molecules and chemical bonds are formed.

For 2A.D2, learners must give three examples of substances (one giant ionic, one giant molecular and one simple molecular) and relate their properties to their bonding and structure. Learners could give examples of the applications of these substances that demonstrate a reliance on these properties.

Learning aim B: Investigate how the uses of chemical substances depend on their chemical and physical properties

For 1B.4, learners could discuss the different types of physical properties of some common chemical substances. They must give brief descriptions of these properties.

For 1B.5, this could be covered by giving learners access to secondary data or research, or they could carry out practical work looking at a variety of chemical changes involving common chemical substances. They must classify at least two changes that are chemical (e.g. interaction with water).

For 2B.P4, learners must link the use of chemical substances to their physical properties and must describe at least two examples.

For 2B.P5, learners must list some common useful chemical products. They may produce a leaflet or poster to do this. They must identify the properties that make these products useful and must link the use of these chemical substances to their chemical properties. They must describe at least two examples.

For 2B.M4, learners could investigate, for example, the physical and chemical properties of substances related to an industry (e.g. cement or plaster in construction) or a use (e.g. mobile phones). Learners could carry out simple comparisons of data for thermal or electrical conductivity, melting point or boiling point and solubilities. They could identify trends in the data and make predictions for chemicals with similar physical properties. Learners could also be given the boiling points of different chemicals and predict their state at room temperature and when under pressure, e.g. the separate fractions obtained from the fractional distillation of crude oil. At least three chemical substances must be studied.

For 2B.D3, learners can be given a range of chemical substances and must assess them for a specified use. They could pick the most appropriate chemical substance for several specified uses. They must explain why the chemical substances are most appropriate for the specified use, in terms of physical and chemical properties. They must look at each property in turn and explain why the property makes it appropriate or inappropriate for the specified use. Learners must then explain why the overall properties make it the most appropriate chemical substance.

Learning aim C: Investigate the factors involved in the rate of chemical reactions

For 1C.6, learners could discuss the factors that can affect the rate of a reaction, to establish what the possible factors could be. They may do this after carrying out some practical investigations. This could be reported in the form of a table.

For 2C.P6, learners must describe these factors. Learners must cover the effects of concentration, particle size, temperature and presence of a catalyst on the rates of chemical reactions, and show that, for example, increasing temperature increases the rate of reaction.

For 2C.M5, learners should explain how changing the rates of reactions affects certain industrial processes.

For 1C.7, learners can be given at least three balanced chemical equations. They must identify the reactants and the products in each of these equations, to include their symbols, state and if the reaction is reversible.

For 2C.P7, they must identify the number and types of atoms in these equations.

For 2C.M6, they must explain the terms 'atom economy' and 'yield' in relation to at least one of these three equations.

For 2C.D4, learners should include an analysis of how different factors affect the rate and yield of an industrial reaction. This should include information on the operating conditions used in industry for the reaction.

Learning aim D: Understand the factors that are affecting the Earth and its environment

For 1D.8, learners must identify at least two human activities that have environmental consequences, as outlined in the content.

For 2D.P8, they must describe the effects of the activities identified in 1D.8.

For 2D.M7, learners must discuss how humans may exercise choices that could limit or worsen the effects of the environmental damage they cause. This could be in relation to the two activities identified in 1D.8. Learners must also discuss how natural factors have changed the atmosphere and surface of the Earth. This could be limited to a specific volcanic eruption or a clash of tectonic plates. Learners must consider the effects of several events, like those identified in 1D.9, which have happened over millions of years.

For 1D.9, learners must identify at least two natural factors, for example, volcanic eruption or movement of tectonic plates.

For 2D.P9, learners must describe the two factors identified for 1D.9.

To achieve 2D.D5, learners should explain how the effects of at least two environmentally damaging natural or human activities may be reduced by evaluating possible solutions. This may be in relation to the activities identified in 1D.8 and/or the factors identified in 1D.9.

Suggested assignment outlines

The table below shows a programme of suggested assignment outlines that cover the assessment criteria. This is guidance and it is recommended that centres either write their own assignments or adapt any assignments we provide to meet local needs and resources.

Criteria covered	Assignment	Scenario	Assessment evidence
1A.1, 2A.P1, 2A.M1, 2A.D1 1A.2, 1A.3, 2A.P2, 2A.P3, 2A.M2, 2A.M3, 2A.D2	Manufacture and quality control of Compounds	You are a chemist working for a large chemical company that has just employed a number of new science technicians. You have been asked to prepare support materials for the new employees explaining the trends in the group 1 and group 7 elements. The support materials are to be given out to the new employees as an introduction to what elements the company uses in its manufacture of products. It is important for quality control laboratory technicians to understand how chemical substances are bonded together, in order for them to carry out laboratory tests on products as they are produced. As part of the induction day for new laboratory technician recruits to your chemical company, you will need to present material showing how compounds and molecules are formed through ionic or covalent bonding, and how their properties are related to the bonding and structure. A visit to a chemical company who manufacture products or a visiting speaker would help put this topic into context.	Prepare a written practical report showing the characteristic features of group 1 and group 7 elements. The report should describe the trends within these groups and explain these trends in terms of electronic structure. Prepare a practical/written report with scientific diagrams and tables on ionic and covalent substances. Include a table comparing at least four properties of each. Include dot-and-cross diagrams of the substances listed to explain how the bonds are formed. Properties must be explained in terms of the binding and structure, and three examples of substances should be given to explain how the application of these substances relies on their specific properties.

Criteria covered	Assignment	Scenario	Assessment evidence
1B.4, 1B.5, 2B.P4, 2B.P5, 2B.M4, 2B.D3	Useful Chemical Products	You work as the senior laboratory technician at a chemical company as part of the quality control team. Your company wants to recruit a number of junior quality control technicians. As part of the induction day your team have been asked to produce information on useful chemical products that the company produces.	Produce an information document on the properties of four useful chemical products and how these properties relate to the application of these products.
1C.6, 1C.7, 2C.P6, 2C.P7, 2C.M5, 2C.M6, 2C.D4	Controlling Industrial Reactions	As one of the production chemists working at the local chemical plant, you have been asked to explain to the chemical plant operatives the factors that affect rate, yield and atom economy of reactions. A visit to a chemical company who manufacture products or a visit from a research chemist or plant chemist would help put this topic into context.	You must provide evidence from experiments and collated data on chemical reactions in order to explain all the factors that make the reaction go faster, maximise yield and optimise atom economy. Produce your findings in a practical scientific report.
1D.8, 1D.9, 2D.P8, 2D.P9, 2D.M7, 2D.D5	Affecting the Environment	The editor of the local paper has asked you, as the chemist responsible for the environmental impact of the company's processes, to respond to an alarmist article written by an environmental group. A visit to an environmental centre or a visit from an environmental scientist would help put this topic into context.	Write a scientific article to present a balanced view of the likely environmental impact of your company and how this may be minimised. The article should also explain the environmental impact of natural events.

Unit 3: Energy and Our Universe

Level: **1 and 2**

Unit type: **Mandatory**

Guided learning hours: **30**

Assessment type: **Internal**

Unit introduction

Nuclear scientists are currently investigating the use of nuclear fusion to gain a source of energy that is safe and does not have the radioactivity issues associated with nuclear fission. Meanwhile, medical physicists are researching ways of improving the use of medical imaging and methods to fight cancer.

In this unit, you will explore ionising radiations, their uses and sources, including alpha, beta, gamma and X-rays. You will also investigate radioactive decay, half-life, nuclear fission and fusion, and issues associated with nuclear energy.

Most electrical devices (televisions, computers, washing machines, etc.) need electrical energy that is transmitted from power stations to homes and businesses to operate. You will be introduced to the basics of electrical circuits, power supplies and the transmission of electrical energy. You will also investigate how this important form of energy is brought to homes.

Our Universe is a fascinating place, which is evolving over time. You will look at the composition of the Solar System, methods of exploring it and the evidence for a constantly changing and expanding Universe.

The aim of this unit is to enable you to develop knowledge and skills related to important fundamental physical concepts. Where possible, this should be done in locally relevant industrial and related contexts such as energy supply and safe working with nuclear materials. With an emphasis on experimental investigations, and to some extent computer simulations, you will also explore some aspects of the physics of our world and beyond.

Learning aims

In this unit you will:

A understand ionising radiation, its uses and sources

B know how electrical energy produced from different sources can be transferred through the National Grid to homes and industry

C know the components of the Solar System, the way the Universe is changing and the methods we use to explore space.

Learning aims and unit content

What needs to be learnt	
Learning aim A: Understand ionising radiation, its uses and sources	
A.1	The structure of nuclei using the terms 'atomic (proton) number' and 'mass (nucleon) number', and using symbols in the format: $^{7}_{3}Li$
A.2	Alpha, beta and gamma radiations are emitted from unstable nuclei in a random process.
A.3	An alpha particle is equivalent to a helium nucleus, a beta particle is an electron emitted from the nucleus and gamma rays are high-frequency electromagnetic waves.
A.4	Ionising radiations cause atoms to gain or lose electrons to form ions.
A.5	Alpha, beta and gamma radiations are compared in terms of their abilities to penetrate and ionise.
A.6	Effects of different radiations on living cells.
A.7	Uses of ionising radiations, including alpha, beta, gamma and X-rays.
A.8	Investigate radioactive decay in terms of reducing activity and amount of radioactive material.
A.9	Investigate half-life of radioactive isotopes in terms of reducing activity.
A.10	Calculations involving half-life and their graphical representations.
A.11	Nuclear fission is large nuclei breaking down to form small nuclei.
A.12	Nuclear fusion is the creation of larger nuclei from smaller nuclei.
A.13	Energy release by the process of controlled nuclear fission.
A.14	Energy release by nuclear fusion in stars and the difficulty in harnessing energy from nuclear fusion on Earth.
A.15	Environmental issues associated with nuclear energy (storage of waste products, uncontrolled release of radioactive material).

What needs to be learnt

Learning aim B: Know how electrical energy produced from different sources can be transferred through the National Grid to homes and industry

B.1 Electric circuits:

a. the need for a complete circuit
b. electrical symbols (battery, cell, switch, fuse, voltmeter, ammeter, resistor, filament lamp)
c. current (A, mA)
d. voltage (V, mV)
e. resistance (Ω, kΩ)
f. construct simple series and parallel circuits
g. measure current and voltage using meters
h. use the equation:

   voltage (volts) = current (amps) × resistance (ohms)

   $V = IR$
i. direct current (d.c.) and alternating current (a.c.).

B.2 Power supplies:

a. types of batteries
b. solar cell
c. simple generators – rotating a coil in a permanent magnetic field
d. production of electricity – basic alternating current generator, batteries as a source of direct current (rechargeable and non-rechargeable)
e. environmental impact – comparison of environmental impact of electricity generation from renewable and non-renewable sources
f. electrical power and the equation:

   power (watts) = voltage (volts) × current (amps)

   $P = VI$
g. efficiency of electricity generation from different sources
h. National Grid – used to transmit electrical energy (power)
i. step-up and step-down transformers and the reduction of energy losses during transmission.

What needs to be learnt
Learning aim C: Know the components of the Solar System, the way the Universe is changing and the methods we use to explore space
C.1 The Universe: a. the structure and dynamic nature of the Universe (Solar System, stars and galaxies, large-scale structure) b. looking back in time. C.2 The Solar System: a. composition – stars, planets, dwarf planets and natural satellites, comets and meteors, asteroids b. formation of the Solar System. C.3 Observing the Universe: a. optical, radio, infrared, UV, X-ray and gamma telescopes b. reflecting, ground-based and space-based telescopes c. space probes and robots. C.4 The changing Universe: a. the Big Bang theory b. evidence for an expanding Universe (galaxies moving away from each other (red shift)) c. cosmic microwave background radiation as support for the Big Bang theory.

Assessment criteria

Level 1	Level 2 Pass	Level 2 Merit	Level 2 Distinction
Learning aim A: Understand ionising radiation, its uses and sources			
1A.1 Describe the structure of atomic nuclei.	2A.P1 Describe half-life in terms of radioactive decay.	2A.M1 Use graphs to explain radioactive decay and half-life.*	2A.D1 Calculate the half-life of radioactive isotopes.*
1A.2 Identify the types of ionising radiation.	2A.P2 Describe the different types of ionising radiation.	2A.M2 Compare the benefits and drawbacks of using radioactive isotopes in the home or workplace.	2A.D2 Justify the selection of a radioactive isotope for a given use within the home or workplace.
1A.3 Identify the problems associated with the use of radioactive isotopes.	2A.P3 Describe the problems associated with the use of radioactive isotopes.		
1A.4 Describe nuclear fission and fusion.	2A.P4 Describe how controllable nuclear fission and fusion reactions are.	2A.M3 Describe the environmental impact of radioactive material from nuclear fission reactors released into the environment.	2A.D3 Evaluate the environmental impacts of a nuclear fission reactor accident, in terms of half-life.*

Level 1	Level 2 Pass	Level 2 Merit	Level 2 Distinction
Learning aim B: Know how electrical energy produced from different sources can be transferred through the National Grid to homes and industry			
1B.5 Identify methods of producing electricity from different sources.	2B.P5 Describe methods of producing a.c. and d.c. electricity.	2B.M4 Compare the efficiency and environmental impact of electricity generated by different sources.*	2B.D4 Assess, in quantitative terms, ways to minimise energy losses either when transmitting electricity or when transforming electricity into other forms for consumer applications.*
1B.6 Demonstrate building simple series and parallel circuits.	2B.P6 Use $V = IR$ to predict values in electric circuit investigations.*	2B.M5 Assess, in qualitative terms, ways to minimise energy losses when transmitting electricity.	
1B.7 Describe electrical power in terms of voltage and current.	2B.P7 Describe how electricity is transmitted to the home or industry.		
Learning aim C: Know the components of the Solar System, the way the Universe is changing and the methods we use to explore space			
1C.8 Identify the components of our Solar System.	2C.P8 Describe the structure of the Universe and our Solar System.	2C.M6 Describe how the Universe and the Solar System were formed.	2C.D5 Evaluate the evidence leading to the Big Bang theory of how the Universe was formed.
1C.9 Identify methods of observing the Universe.	2C.P9 Describe the suitability of different methods for observing the Universe.	2C.M7 Explain how evidence shows that the Universe is changing.	
1C.10 Describe the dynamic nature of our Solar System and Universe.	2C.P10 Identify evidence that shows the dynamic nature of the Universe.		

*Opportunity to assess mathematical skills

#Opportunity to assess English skills

Teacher guidance

Resources

There are no special resources needed for this unit.

Assessment guidance

This unit is assessed internally by the centre and externally verified by Pearson. Please read this guidance in conjunction with S*ection 8 Internal assessment*.

The contents of this unit should be approached from a practical point of view as far as possible, with simulations used where necessary, e.g. simulations into the nature of radioactivity. Industrial and related contexts for assessment should be locally relevant where possible and could include:

- for learning aim A, safe working with, and disposal of, nuclear materials in the medical industry
- for learning aim B, approaches taken by a local energy supplier to responsibly manage demand.

Level 1 exemplifies partial achievement within a level 2 learning aim.

Learning aim A: Understand ionising radiation, its uses and sources

For 1A.1, learners must show the structure of the atomic nuclei, most probably pictorially, using numbers and symbols.

For 2A.P1, only a description of half-life is required in terms of radioactive decay; there is no requirement for a qualitative or quantitative explanation.

For 2A.M1, learners are given the opportunity to describe, in words and mathematically, radioactive decay and half-life. Following on from this, in 2A.D1 the learner is required to perform calculations involving the half-life of radioactive isotopes. The teacher and assessor should avoid providing learners with a series of questions that are just exercises in calculations. The problems should be set in context, perhaps using the results from simulations the learners have watched. The idea is to enable the learner to carry out calculations and, in doing so, understand how published figures for half-lives are arrived at.

For 1A.2, the learner is required to identify types of ionising radiation; this could be done in the form of a list or table.

For 2A.P2, the learner will need to show an understanding of atomic structure and the different types of ionising radiation, related to the structure described in 1A.1.

For 1A.3, the learners could give uses of radioactive isotopes in a table with a column identifying at least two problems with these uses.

For 2A.P3, the learners would need to describe at least two problems with the use of radioactive isotopes.

For 2A.M2, it is also expected that the learner can compare the benefits and drawbacks of using radioactive isotopes in the home (such as in smoke detectors) or in the workplace (such as for sterilising medical equipment, radioactive tracers and measuring the thickness of paper).

For 2A.D2, learners will need to justify the selection of one radioactive isotope.

For 1A.4, learners can use simple atomic nuclei structure diagrams to describe nuclear fission and fusion.

2A.P4 requires a description of how controllable nuclear fission and fusion reactions are, and it would be expected that learners would refer to examples from nuclear reactors and the Solar System to aid their description. They are not being asked to compare these two reactions.

For 2A.M3, learners need to describe the environmental impact of radioactive uncontrolled release from a nuclear reactor. This could be a recent event that has long-term effects on the environment.

For 2A.D3, learners need to evaluate the impact of an accident in terms of using half-life diagrams.

Learning aim B: **Know how electrical energy produced from different sources can be transferred through the National Grid to homes and industry**

For 1B.5, learners need to identify four different methods of producing electricity. This could be done after having been given a case study of methods of producing electricity.

For 2B.P5, learners will need to describe the four different methods identified for 1B.5.

For 1B.6 and 1B.7, learners can be observed carrying out the tasks to gain these assessment criteria. Note that it is stipulated they must be done correctly. Observation sheets and/or witness statements are required as evidence.

It is assumed that practical work has been done on circuit building etc. in order to underpin the learners' ability in 2B.P6 to use the equation $V = IR$. Teachers may feel that the assessment of 2B.P6 and 2B.P7, where an understanding of a.c. and d.c. currents and the transmitting of electricity is required, can be linked together.

2B.M4 requires learners to carry out a comparison in relation to efficiency. More able learners could include calculations to aid their arguments, rather than just giving a description. 2B.M5 asks for qualitative assessments on minimising energy losses. In doing this, learners may well include quantitative arguments, which the assessor needs to look at for assessment as part of 2B.D4.

Learning aim C: **Know the components of the Solar System, the way the Universe is changing and the methods we use to explore space**

For 1C.8, learners need to identify the components of our Solar System; this could be done in the form of a diagram or model, including planets, stars, natural satellites, etc.

For 2C.P8, learners need to describe the structure of the Universe and our Solar System. This can be done as a large-scale structure to include galaxies, stars and solar systems.

To achieve 2C.M6, learners need to give a simple description of the Big Bang theory and formation of the Solar System.

For 1C.9, learners must identify three different methods of observing the Universe.

For 2C.P9, learners need to describe the suitability of the three different methods provided for 1C.9.

For 1C.10, learners should provide a simple description of the dynamic nature of the Solar System and Universe, such as stars evolving and the Universe expanding.

For 2C.P10, evidence needs to be identified by looking at the red shift of galaxies.

2C.M7 can be achieved by using evidence of an expanding Universe and cosmic microwave background radiation.

For 2C.D5, this may be covered by the learners in one answer. The answer in 2C.D5 must be an evaluation as the expectation is that the ideas and evidence which led to the Big Bang theory are explored, not just described.

Suggested assignment outlines

The table below shows a programme of suggested assignment outlines that cover the assessment criteria. This is guidance and it is recommended that centres either write their own assignments or adapt any assignments we provide to meet local needs and resources.

Criteria covered	Assignment	Scenario	Assessment evidence
1A.1, 1A.2, 1A.3, 1A.4, 2A.P1, 2A.P2, 2A.P3, 2A.P4, 2A.M1, 2A.M2, 2A.M3, 2A.D1, 2A.D2, 2A.D3	Do They Always Glow in the Dark?	Working as a physicist for a government science department, you are required to produce a report to explain the topic of radiation to schools and colleges in reaction to bad publicity associated with using radioactive materials.	A report with graphs, example calculations, benefits, advantages and drawbacks to be distributed to schools and colleges.
1B.5, 2B.P5, 2B.M4 2B.P5, 2B.P7, 2B.M5, 2B.D4 1B.6, 1B.7, 2B.P6	Making Electricity – Really!	You are a trainee electrical physicist working for the National Grid. Produce a presentation with scientific diagrams and tables describing how electricity can be produced. You have been asked to promote the company by producing a scientific report explaining how electrical energy is generated and transferred to a factory or a customer's home. (A visit to an energy company or a visiting speaker from an energy company would help put this topic into context.) You must show your supervisor that you have a practical understanding of circuits and can carry out calculations.	A presentation with scientific diagrams and tables. A scientific report with diagrams, calculations and tables. Report including calculations/observation of practical work/presentation from experiment results.

Criteria covered	Assignment	Scenario	Assessment evidence
1C.8, 1C.9, 1C.10, 2C.P8, 2C.P9, 2C.P10, 2C.M6, 2C.M7, 2C.D5	Where Is All that Space?	Working for the Royal Observatory at Greenwich, you have been asked to produce models and diagrams to give a talk to the public to describe the Universe. A visit to an observatory or a visiting astronomer would help put this topic into context.	A presentation, including models and diagrams.

Unit 4: Biology and Our Environment

Level: **1 and 2**

Unit type: **Mandatory**

Guided learning hours: **30**

Assessment type: **Internal**

Unit introduction

Environmental science technicians and scientists work for local authorities, the government and charities to monitor the effects of human activities on local, national and global environments.

You will study the different activities that humans carry out that cause damage to the environment. You will gain an understanding of how the pollutants released from human activities affect air, water and land, using primary and/or secondary data to determine how different pollutants affect living things. The use of indicators in measuring pollution levels is explored and you will study the methods and schemes used to try to reduce or counteract the effects of human activity on the environment.

Scientists in health programmes monitor the various factors that impact on human health and seek to improve the health of the population. To complete your study of this unit, you will investigate the causes of disease, including genetic disease, and how various diseases can be prevented and treated. You will have the opportunity to investigate the problems associated with the misuse of treatment regimes and implications that resistant forms of bacteria have on the future treatment of disease.

You will study and compare the adaptations of different organisms and how these adaptations determine the success of organisms in their environment. You will have the opportunity to demonstrate how adaptations bring about evolution or, on the contrary, bring about species extinction.

The aim of this unit is to further develop your understanding of the core concepts you have learnt in Unit 1 by studying relationships between different organisms and the environment. Where possible this should be done using industrial and related contexts such as local government monitoring of the environmental impact of industries and proper use of medicines.

Learning aims

In this unit you will:

A investigate the relationships that different organisms have with each other and with their environment

B demonstrate an understanding of the effects of human activity on the environment and how these effects can be measured

C explore the factors that affect human health.

Learning aims and unit content

What needs to be learnt
Learning aim A: Investigate the relationships that different organisms have with each other and with their environment
A.1 The characteristics of organisms vary within and across species: a. genetic variation – variation in characteristics can be caused by genes, including genetic mutation b. environmental variation – some characteristics can be influenced by the environment.
A.2 Evolution is a gradual process, involving gene mutation and natural selection, that can lead to the development of new species: a. populations or organisms show variation b. organisms less well adapted to their environment are less likely to survive due to competition for resources, predation and environmental influences c. organisms best adapted to their environment will survive to breed and pass on their genes to the next generation d. over a period of time the proportion of individuals with the favourable adaptation will increase and the individuals without the adaptation may disappear altogether.
A.3 Interdependence of organisms can be illustrated using food chains and webs, and by predator–prey relationships.
A.4 Organisms are classified depending on their characteristics: a. the main characteristics of the five kingdoms b. division of the animal kingdom into vertebrates and invertebrates c. the main characteristics of vertebrates.
A.5 Construct and use keys to show how organisms can be identified.

What needs to be learnt
Learning aim B: Demonstrate an understanding of the effects of human activity on the environment and how these effects can be measured
B.1 How human activities alter ecosystems through: a. deforestation to supply timber and clear land for agriculture b. agriculture to meet an increasing demand for food c. transportation – of food and for travel. B.2 How pollutants produced as a result of human activity can affect ecosystems: a. overuse of fertiliser causing eutrophication b. toxic herbicides and pesticides that can bioaccumulate and disrupt terrestrial and aquatic food chains. B.3 Living and non-living indicators can be used as a measure of the level of pollution in an ecosystem: a. lichens are sensitive to sulfur dioxide b. algae and freshwater shrimps as indicators of water pollution c. dissolved oxygen and nitrate concentration in water as non-living indicators of water pollution d. limestone buildings can be eroded by acid rain. B.4 There are measures that can be taken to counteract or reduce the impact of pollutants on ecosystems: a. recycling and reusing materials saves natural resources and reduces the amount of waste produced b. conservation techniques of reforestation, replacement planting and breeding programmes c. use of renewable resources d. using organic fertilisers and biological pest control as an alternative to chemical fertilisers and pesticides.

What needs to be learnt	
Learning aim C: Explore the factors that affect human health	
C.1	Infectious disease can be caused by microorganisms (bacteria and viruses) that affect living cells: a. bacteria produce toxins that harm living cells b. viruses invade living cells causing cell death.
C.2	The methods used to prevent and treat disease: a. vaccinations can be used to prevent disease b. antibiotics can be used to treat disease caused by bacteria.
C.3	Bacteria can become resistant to antibiotics.
C.4	Non-infectious disease can be caused by lifestyle or the environment: a. misuse of recreational drugs can lead to mental illness b. inadequate diet can lead to deficiency diseases c. cigarette smoke can cause diseases of the circulatory system d. ultraviolet light can cause skin cancer e. excessive consumption of alcohol can lead to liver disease f. poor air quality can lead to asthma.
C.5	Influence of genes on human health: a. genetic disorders can affect human health b. pedigree analysis can be used to show the inheritance of genetic disease.
C.6	Physical activity helps to keep the body healthy.

Assessment criteria

Level 1	Level 2 Pass	Level 2 Merit	Level 2 Distinction
Learning aim A: Investigate the relationships that different organisms have with each other and with their environment			
1A.1 Distinguish between variation due to genes and variation due to environmental factors.	2A.P1 Describe the role of genes and the environment in variation.	2A.M1 Explain the role of genes and the environment in evolution.	2A.D1 Evaluate the impact of genes and the environment on the survival or extinction of organisms.
1A.2 Construct simple keys to classify organisms.	2A.P2 Describe how characteristics are used to classify organisms.	2A.M2 Discuss the factors that affect the relationship between different organisms.	
1A.3 Construct food chains and food webs.	2A.P3 Describe the different ways in which organisms show interdependence.		

Level 1	Level 2 Pass	Level 2 Merit	Level 2 Distinction
Learning aim B: Demonstrate an understanding of the effects of human activity on the environment and how these effects can be measured			
1B.4 Identify human activities that affect an ecosystem.	2B.P4 Describe the impact that different human activities have on ecosystems.	2B.M3 Analyse the effects of pollutants on ecosystems.	2B.D2 Explain the long-term effects of pollutants on living organisms and ecosystems.
1B.5 Identify living and non-living indicators and the type of pollution they measure.	2B.P5 Describe how living and non-living indicators can be used to measure levels of pollutants.	2B.M4 Discuss the advantages and disadvantages of methods used to reduce the impact of human activity on ecosystems.	2B.D3 Evaluate the success of methods to reduce the impact of human activity on an ecosystem, for a given scenario.
1B.6 Describe how recycling and reusing materials can reduce the impact that human activities have on an ecosystem.	2B.P6 Describe the different methods used to help reduce the impact of human activities on ecosystems.		

Level 1	Level 2 Pass	Level 2 Merit	Level 2 Distinction
Learning aim C: Explore the factors that affect human health			
1C.7 List the different biological, social and inherited factors that affect human health.	2C.P7 Describe how pathogens affect human health.	2C.M5 Explain how bacteria can become resistant to antibiotics.	2C.D4 Evaluate the use of antibiotics, pedigree analysis and vaccination programmes in the treatment and prevention of childhood illnesses.*
1C.8 Identify measures that can be taken to prevent and treat infectious disease.	2C.P8 Describe two different treatment regimes: one used to prevent a disease and one used to treat a disease.	2C.M6 Explain the use of pedigree analysis.	
1C.9 List some benefits of exercise on health.	2C.P9 Describe how lifestyle choices can affect human health.	2C.M7 Discuss the advantages and disadvantages of vaccination programmes.	

*Opportunity to assess mathematical skills

#Opportunity to assess English skills

Teacher guidance

Resources

There are no special resources needed for this unit.

Assessment guidance

This unit is assessed internally by the centre and externally verified by Pearson. Please read this guidance in conjunction with s*ection 8 Internal assessment*.

The contents of this unit should be approached from a practical point of view as far as possible, e.g. through scientific investigative assignments. Industrial and related contexts for assessment should be locally relevant where possible and could include:

- for learning aims A and B, approaches to monitoring the impact of industry on local species
- for learning aim C, approaches to ensuring best use of antibiotics and vaccinations by local health organisations.

Level 1 exemplifies partial achievement within a level 2 learning aim.

Learning aim A: **Investigate the relationships that different organisms have with each other and with their environment**

For 1A.1, learners will be expected to identify the different ways in which organisms vary and how this variation is brought about. They will be able to distinguish between simple genetic characteristics and characteristics that are a result of the environment. At this level, learners will not be expected to describe characteristics that are influenced by both genes and the environment. The information that learners submit could be presented in a simple, clear table.

For 2A.P1, learners will be expected to describe how genes and the environment influence variation with evidence to show understanding of how genetic factors can also be influenced by lifestyle or the environment. Learners will be able to draw on their knowledge and understanding of information gained in Unit 1 to describe how genes determine the basis for many characteristics and could demonstrate their understanding of this using genetic diagrams or Punnett squares. Learners should be able to identify genetic characteristics that can be altered by the environment, for example, weight or height – and give a brief description of how lifestyle or the environment affects these characteristics.

Learners at Merit grade, 2A.M1, will develop their understanding further to link strong characteristics with survival of the organism, showing in their evidence how natural selection is one of the key processes involved in evolutionary change.

For 1A.2, learners will be able to pick out key characteristics of organisms and use these characteristics to classify the organisms into appropriate groups. Learners will be expected to know the main characteristics of the five kingdoms, as well as the main characteristics of the vertebrates and invertebrates, giving examples of organisms that fall into each group. This will involve the construction and use of keys to cover the criterion for 1A.3 to help identify organisms, food chains and food webs.

For 2A.P2, learners need to classify organisms using characteristics and describe how to do this. Learners may link this information to the interdependence of organisms to provide evidence for 2A.P3 by stating how the characteristics of organisms determine their place in food chains and webs. Further evidence for this criterion could be provided in annotated diagrams, posters or flow charts that give details on the different ways in which organisms depend on each other, other than just feeding

relationships. It is expected that learners will provide information on at least two different types of interdependent relationships, which will include the detail derived from food chains and webs.

At Merit level, 2A.M2, learners need to discuss how different factors affect the relationship between different organisms.

At Distinction level, 2A.D1, learners will provide clear evidence in their evaluation of how genes and the environment impact on evolution, including information on how these factors, as well as gene mutation, can lead to the extinction of species or the formation of new species.

Coverage of learning aim A could be obtained by producing wall displays, presentations or information leaflets that provide learners with the opportunity to use their imagination and creative talents, as well as to encourage tiered learning that promotes access to the higher grades.

Learning aim B: Demonstrate an understanding of the effects of human activity on the environment and how these effects can be measured

The study of learning aim B should lead learners to realise why it is important for us to take measures to ensure that the future of our planet is safe, and that there are practices that can be put in place to reduce or counteract the effects of the pollutants that are released into ecosystems.

For 1B.4, learners could produce a table of information that details various human activities, the pollutants produced as a result of these activities and brief details on how these pollutants affect an ecosystem. It is expected that learners will cover the material listed in B.1 a, b and c and B.2 a and b of the content to meet this criterion. Less able learners can be supported by being provided with named pollutants that they can research to find out their effects on the environment.

To meet 2B.P4, learners will need to identify the different human activities that affect ecosystems and describe how the polluting effects of these activities cause harm to living organisms and ecosystems.

Learners have the opportunity to carry out investigative work to meet this criterion which could also allow greater access to the Merit grade criterion, 2B.M3, where learners are expected to use data to support the fact that human activities do have polluting effects. For this criterion, learners may wish to study global temperature change over time and relate this to the concentration of carbon dioxide released, or analyse the effects of the overuse of fertiliser on ecosystems.

Learners working at Distinction grade, for 2B.D2, will be expected, to research information and use their own understanding gained from the study of this unit to explain how pollutants could affect the ecosystems in the future. This work will include the effects on living organisms, including species survival, the effect on food chains and webs, and how these may be disrupted, with information that illustrates understanding of how the release of pollutants, if remaining unchecked, will affect humans.

For 1B.5, level 1 learners need to have a knowledge of what living and non-living indicators are. They should be able to distinguish between the two and give examples of each, stating the type of pollution that they can be used to indicate.

For 2B.P5, learners will recognise the different indicators that can be used to measure levels of specific pollutants, working independently to provide evidence that could be in the form of a report, a case study or a presentation.

To meet the criterion for 1B.6, learners will be able to identify modern methods used to help reduce the impact of human activity on an ecosystem. They should be able to identify the types of household materials that can be recycled and reused, and describe very simply why these methods help to reduce the effects of human activity

on an ecosystem. Learners may be able to provide information from their own experiences, such as reusing plastic bags, and some may develop their learning by naming national initiatives such as the use of 'bags for life' that could allow them to access higher grades.

For 2B.P6, learners may focus their study on local schemes that may have been put in place, such as recycling centres or local supermarkets that may have strategies in place to help conserve natural resources or encourage recycling methods. At this level, learners will be expected to understand how such schemes help to counteract the polluting effects of human activities on the environment's ecosystems and provide evidence to show how sustainable activities, such as recycling and reusing materials, will help to conserve natural resources for future generations.

For 2B.M4, learners will show understanding of the advantages and disadvantages of 'green schemes' such as recycling and this could be presented as an extension to the information submitted for 2B.P6.

For 2B.D3, learners will provide evidence in their evaluation to show whether the various methods used to reduce or counteract the effects of pollution are successful and will suggest ways in which methods could be improved, or participation by communities could be improved. Learners may suggest alternative methods that could be introduced that would further help to counteract the effects of pollutants on the environment and ecosystems. Learners will also be expected to extend their understanding to methods not covered at the lower grades, such as coppicing and reforestation techniques.

Learning aim C: Explore the factors that affect human health

To meet the criterion for 1C.7, learners will produce evidence to show their knowledge of the factors that affect human health. Learners will be expected to know the effects of at least two pathogens on human health: one bacteria and one virus. It is expected that learners will give brief details of the effects of these factors on the body; this could be produced in the form of a leaflet, a presentation or a report that can provide the opportunity for a vocational context to be incorporated into their work.

Learners will meet the criterion for 2C.P7 by identifying and describing the pathogen that affects human health; this will be limited to bacteria and viruses. A description of the action of bacteria and viruses and how this impacts on human health is required.

At Merit grade, 2C.M5, learners will need a knowledge of the increasing concern caused by bacterial resistance to antibiotics and the reasons why it is important to follow treatment regimes strictly, as well as to ensure that the use of antibiotics is not abused. The work that learners submit for 2C.M5 should include information on how bacteria have become resistant to treatments and what implications this may have in the future.

Information to meet the criterion for 1C.8 could also be included here where learners will provide evidence to show their knowledge of the use of vaccinations in the prevention of disease and the use of antibiotics in the treatment of disease. Learners do not need to provide details of how vaccinations instigate an immune response or how antibiotics work to destroy bacteria. Other methods in preventing disease will be covered to provide evidence for 1C.8, limited to personal hygiene and brief details on the safe storage and cooking of food.

For 2C.P8, learners will provide evidence to show their knowledge of how disease can be prevented using vaccination programmes and treated using antibiotics.

At Merit grade, 2C.M6, learners will need to show one example of the use of pedigree analysis.

For 1C.9, learners will produce evidence to show their knowledge of how exercise benefits health.

For 2C.P9, learners will need a knowledge of how lifestyle choices can affect human health both positively and negatively. This includes smoking, diet, exercise and recreational drug use.

For 2C.M7, high profile examples such as MMR safety concerns balanced against the dangers of measles give an excellent context for learners to discuss using widely available information.

For 2C.D4, learners need to extend the Merit level by evaluating the use of antibiotics, pedigree analysis and vaccination programmes in the treatment and prevention of childhood illnesses. Historical health campaign information may be useful. One example of each is expected.

Suggested assignment outlines

The table below shows a programme of suggested assignment outlines that cover the assessment criteria. This is guidance and it is recommended that centres either write their own assignments or adapt any assignments we provide to meet local needs and resources.

Criteria covered	Assignment	Scenario	Assessment evidence
1A.1, 1A.2, 1A.3, 2A.P1, 2A.P2, 2A.P3, 2A.M1, 2A.M2, 2A.D1	Threat to the Ecosystem	You are a council officer who has been asked to advise on the impact of a declining population of an organism on other organisms in an ecosystem. A visit from an environmental scientist would help put this topic into context.	Report or fieldwork evidence with scientific diagrams and flow charts.
1B.4, 1B.5, 1B.6, 2B.P4, 2B.P5, 2B.P6, 2B.M3, 2B.M4, 2B.D2, 2B.D3	Advising Industry About Impact on Ecosystems	You are an environmental scientist advising an industrial company. You have been asked to present to the company the possible impact on local ecosystems of some suggested new schemes, and recommend what can be done to monitor and limit the impact on the environment.	Report or fieldwork evidence with scientific diagrams.
1C.7, 1C.8, 1C.9, 2C.P7, 2C.P8, 2C.P9, 2C.M5, 2C.M6, 2C.M7, 2C.D4	Improving the Use of Medicines	You are a government scientist who has been asked to present your views on how to improve the use of antibiotics and vaccinations in the local area. A visit to a hospital pharmaceutical department or visit from a pharmacist would help put this topic into context.	Scientific report with appropriate diagrams and tables.

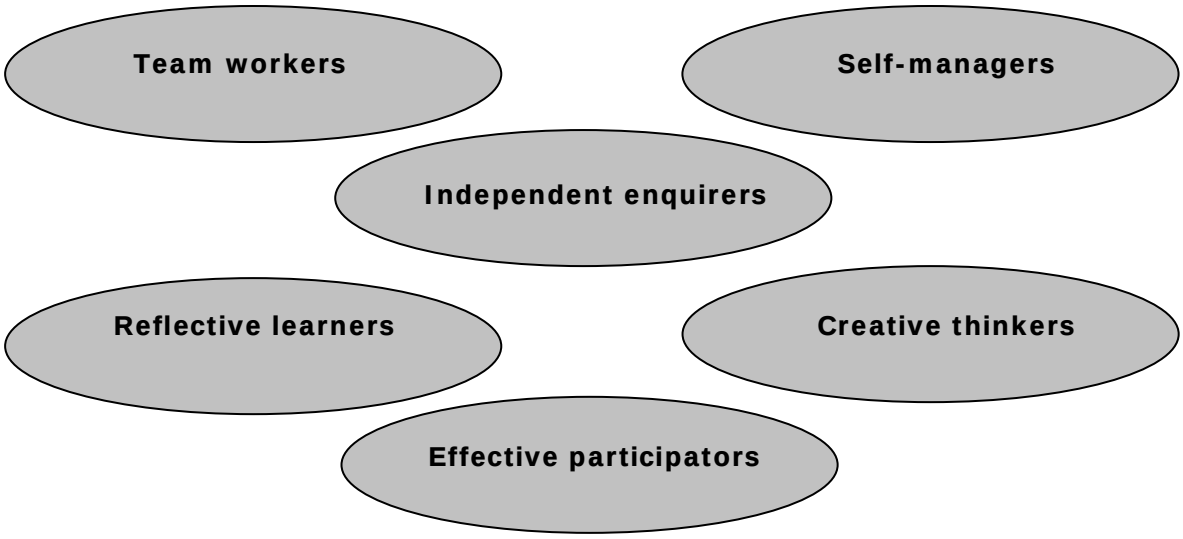
Annexe A

Personal, learning and thinking skills

A FRAMEWORK OF PERSONAL, LEARNING AND THINKING SKILLS 11–19 IN ENGLAND

The framework comprises six groups of skills that are essential to success in learning, life and work. In essence, the framework captures the essential skills of: managing self; managing relationships with others; and managing own learning, performance and work. It is these skills that will enable young people to enter work and adult life confident and capable.

The titles of the six groups of skills are set out below.



For each group, there is a focus statement that sums up the range of skills. This is followed by a set of outcome statements that are indicative of the skills, behaviours and personal qualities associated with each group.

Each group is distinctive and coherent. The groups are also interconnected. Young people are likely to encounter skills from several groups in any one learning experience. For example, an independent enquirer would set goals for their research with clear success criteria (reflective learner) and organise and manage their time and resources effectively to achieve these (self-manager). In order to acquire and develop fundamental concepts such as organising oneself, managing change, taking responsibility and perseverance, learners will need to apply skills from all six groups in a wide range of learning contexts.

The skills

Independent enquirers
Focus: Young people process and evaluate information in their investigations, planning what to do and how to go about it. They take informed and well-reasoned decisions, recognising that others have different beliefs and attitudes.
Young people: ● identify questions to answer and problems to resolve ● plan and carry out research, appreciating the consequences of decisions ● explore issues, events or problems from different perspectives ● analyse and evaluate information, judging its relevance and value ● consider the influence of circumstances, beliefs and feelings on decisions and events ● support conclusions, using reasoned arguments and evidence.

Creative thinkers
Focus: Young people think creatively by generating and exploring ideas, making original connections. They try different ways to tackle a problem, working with others to find imaginative solutions and outcomes that are of value.
Young people: ● generate ideas and explore possibilities ● ask questions to extend their thinking ● connect their own and others' ideas and experiences in inventive ways ● question their own and others' assumptions ● try out alternatives or new solutions and follow ideas through ● adapt ideas as circumstances change.

Reflective learners
Focus: Young people evaluate their strengths and limitations, setting themselves realistic goals with criteria for success. They monitor their own performance and progress, inviting feedback from others and making changes to further their learning.
Young people: ● assess themselves and others, identifying opportunities and achievements ● set goals with success criteria for their development and work ● review progress, acting on the outcomes ● invite feedback and deal positively with praise, setbacks and criticism ● evaluate experiences and learning to inform future progress ● communicate their learning in relevant ways for different audiences.

Team workers
Focus: Young people work confidently with others, adapting to different contexts and taking responsibility for their own part. They listen to and take account of different views. They form collaborative relationships, resolving issues to reach agreed outcomes.
Young people: ● collaborate with others to work towards common goals ● reach agreements, managing discussions to achieve results ● adapt behaviour to suit different roles and situations, including leadership roles ● show fairness and consideration to others ● take responsibility, showing confidence in themselves and their contribution ● provide constructive support and feedback to others.

Self-managers
Focus: Young people organise themselves, showing personal responsibility, initiative, creativity and enterprise with a commitment to learning and self-improvement. They actively embrace change, responding positively to new priorities, coping with challenges and looking for opportunities.
Young people: ● seek out challenges or new responsibilities and show flexibility when priorities change ● work towards goals, showing initiative, commitment and perseverance ● organise time and resources, prioritising actions ● anticipate, take and manage risks ● deal with competing pressures, including personal and work-related demands ● respond positively to change, seeking advice and support when needed.

Effective participators
Focus: Young people actively engage with issues that affect them and those around them. They play a full part in the life of their school, college, workplace or wider community by taking responsible action to bring improvements for others as well as themselves.
Young people: ● discuss issues of concern, seeking resolution where needed ● present a persuasive case for action ● propose practical ways forward, breaking these down into manageable steps ● identify improvements that would benefit others as well as themselves ● try to influence others, negotiating and balancing diverse views to reach workable solutions ● act as an advocate for views and beliefs that may differ from their own.

Summary of the PLTS coverage throughout the programme

This table shows where units support the development of personal, learning and thinking skills.

Key:

✓ indicates opportunities for development

a blank space indicates no opportunities for development

Unit	Personal, learning and thinking skills					
	Independent enquirers	Creative thinkers	Reflective learners	Team workers	Self-managers	Effective participators
Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science						
1	✓					
2	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	
4	✓	✓	✓	✓	✓	✓

Annexe B

English knowledge and skills signposting

This table shows where an assessment criterion in a BTEC First unit can provide an opportunity to practise a subject content area from the GCSE English subject criteria (including functional elements).

Unit no. and title	Learning aim	Assessment criterion reference	Subject content area from the GCSE subject criteria (details of the content area can be found below)
Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science			
Unit 1: Principles of Science (External)	N/A	N/A	N/A
Unit 2: Chemistry and Our Earth	N/A	N/A	N/A
Unit 3: Energy and Our Universe	N/A	N/A	N/A
Unit 4: Biology and Our Environment	N/A	N/A	N/A

GCSE English subject content area

The topic areas below are drawn from the GCSE English subject criteria.

Learners should:

1 analyse spoken and written language, exploring impact and how it is achieved

2 express ideas and information clearly, precisely, accurately and appropriately in spoken and written communication

3 form independent views and challenge what is heard or read on the grounds of reason, evidence or argument

4 understand and use the conventions of written language, including grammar, spelling and punctuation

5 explore questions, solve problems and develop ideas

6 engage with and make fresh connections between ideas, texts and words

7 experiment with language to create effects to engage the audience

8 reflect and comment critically on their own and others' use of language.

In speaking and listening, learners should:

9 present and listen to information and ideas

10 respond appropriately to the questions and views of others

11 participate in a range of real-life contexts in and beyond the classroom, adapting talk to situation and audience and using standard English where appropriate

12 select and use a range of techniques and creative approaches to explore ideas, texts and issues in scripted and improvised work.

In reading, learners should:

13 understand how meaning is constructed through words, sentences and whole texts, recognising and responding to the effects of language variation

14 evaluate the ways in which texts may be interpreted differently according to the perspective of the reader.

In writing, learners should write accurately and fluently:

15 choosing content and adapting style and language to a wide range of forms, media, contexts, audiences and purposes

16 adapting form to a wide range of styles and genres.

Annexe C

Mathematics knowledge and skills signposting

This table shows where an assessment criterion in a BTEC First unit can provide an opportunity to practise a subject content area from the GCSE Mathematics subject criteria (including functional elements).

Unit no. and title	Learning aim	Assessment criterion reference	Subject content area from the GCSE subject criteria (details of the content area can be found below)
Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science			
Unit 1: Principles of Science (External)	A	N/A	1–7, 17, 21
	C	N/A	1–6, 13, 21, 22, 24
	D, E, F	N/A	1–6, 13, 21, 24
Unit 2: Chemistry and Our Earth	C	2C.P7	1–6, 13, 21, 24
Unit 3: Energy and Our Universe	A	2A.M1, 2A.D1	1–6, 12, 14, 16, 21
		2A.D3	1–6, 12, 14, 16, 21, 22
	B	2B.P6, 2B.M4, 2B.D4	1–6, 12, 14, 16, 21, 24
Unit 4: Biology and Our Environment	C	2C.D4	8, 12, 14–16, 21

GCSE Mathematics subject content area

The topic areas below are drawn from the GCSE Mathematics subject criteria.

Learners should be able to:

1 understand number size and scale and the quantitative relationship between units

2 understand when and how to use estimation

3 carry out calculations involving +, –, ×, ÷, either singly or in combination, decimals, fractions, percentages and positive whole number powers

4 understand and use number operations and the relationships between them, including inverse operations and the hierarchy of operations

5 provide answers to calculations to an appropriate degree of accuracy, including a given power of ten, number of decimal places and significant figures

6 understand and use the symbols =, <, >, ~

7 understand and use direct proportion and simple ratios

8 calculate arithmetic means

9 understand and use common measures and simple compound measures such as speed

10 make sensible estimates of a range of measures in everyday settings and choose appropriate units for estimating or carrying out measurement

11 interpret scales on a range of measuring instruments, work out time intervals and recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction

12 plot and draw graphs (line graphs, bar charts, pie charts, scatter graphs, histograms) selecting appropriate scales for the axes

13 substitute numerical values into simple formulae and equations using appropriate units

14 translate information between graphical and numerical form

15 design and use data-collection sheets, including questionnaires, for grouped, discrete or continuous data, process, represent, interpret and discuss the data

16 extract and interpret information from charts, graphs and tables

17 understand the idea of probability

18 calculate area and perimeters of shapes made from triangles and rectangles

19 calculate volumes of right prisms and of shapes made from cubes and cuboids

20 use Pythagoras' theorem in 2-D

21 use calculators effectively and efficiently.

In addition, level 2 learners should be able to:

22 interpret, order and calculate with numbers written in standard form

23 carry out calculations involving negative powers (only -1 for rate of change)

24 change the subject of an equation

25 understand and use inverse proportion

26 understand and use percentiles and deciles

27 use Pythagoras' theorem in 2-D and 3-D

28 use trigonometric ratios to solve 2-D and 3-D problems.

Annexe D

Synoptic assessment

Synoptic assessment in applied science is embedded throughout the assessment criteria across the units of study. The mandatory units provide the essential knowledge, understanding and skills required in applied science. Learners studying the Pearson Level 1/Level 2 BTEC First Award in Principles of Applied Science are able to demonstrate a number of synoptic approaches towards meeting the assessment criteria which includes:

- showing links and holistic understanding/approaches to units of study from the specification
- being able to interrelate overarching concepts and issues, bringing together their scientific knowledge
- drawing together and integrating knowledge, understanding and skills across different units, in order to develop an appreciation of how topics relate to one another, how each may contribute to different scientific contexts/situations
- applying scientific knowledge and approaches to particular vocational contexts or situations
- demonstrating their ability to use and range of investigative methods and techniques
- being able to put forward different perspectives and/or explanations to support decisions they have made or evidence presented
- synthesising information gained from studying a number of different vocational contexts
- applying knowledge, understanding and a range of scientific skills from across different units to a particular vocational context
- using specialist terminology where appropriate
- demonstrating use of transferable skills
- evaluating and justifying their decisions, choices and recommendations.

Unit 1: Principles of Science introduces learners to the fundamental areas of biology, chemistry and physics, which they will then study further in Units 2, 3 and 4. Therefore Units 2, 3 and 4 are synoptic in nature, drawing together the knowledge and understanding that the learners developed in Unit 1. These units also develop practical skills and introduce the vocational contexts in biology, chemistry and physics.

Annexe E

Mapping of the Pearson BTEC Level 1/Level 2 First Award in Principles of Applied Science and the Key Stage 4 Science Programme of Study

Science KS4 programme of study	Unit 1 – Principles of Science	Unit 2 – Chemistry and Our Earth	Unit 3 – Energy and Our Universe	Unit 4 – Biology and Our Environment
1. Organisms and health				
a. organisms are interdependent and adapted to their environments				A investigate the relationships that different organisms have with each other and with their environment
b. variation within species can lead to evolutionary changes and similarities and differences between species can be measured and classified				A investigate the relationships that different organisms have with each other and with their environment
c. the ways in which organisms function are related to the genes in their cells				A investigate the relationships that different organisms have with each other and with their environment

Science KS4 programme of study	Unit 1 – Principles of Science	Unit 2 – Chemistry and Our Earth	Unit 3 – Energy and Our Universe	Unit 4 – Biology and Our Environment
d. chemical and electrical signals enable body systems to respond to internal and external changes, in order to maintain the body in an optimal state	A explore the structure and function of eukaryotic cells B explore the roles of the nervous and endocrine systems in homeostasis and communication			
e. human health is affected by a range of environmental and inherited factors, by the use and misuse of drugs and by medical treatments				C explore the factors that affect human disease

Science KS4 programme of study	Unit 1 – Principles of Science	Unit 2 – Chemistry and Our Earth	Unit 3 – Energy and Our Universe	Unit 4 – Biology and Our Environment
2. Chemical and material behaviour				
a. chemical change takes place by the rearrangement of atoms in substances	C explore atomic structure and the periodic table D explore substances and chemical reactions	A investigate chemical reactivity and bonding		
b. there are patterns in the chemical reactions between substances	D explore substances and chemical reactions	A investigate chemical reactivity and bonding C investigate the factors involved in the rate of chemical reactions		
c. new materials are made from natural resources by chemical reactions		D understand the factors that are affecting the Earth and its environment		
d. the properties of a material determine its uses		B investigate how the uses of chemical substances depend on their chemical and physical properties		

Science KS4 programme of study	Unit 1 – Principles of Science	Unit 2 – Chemistry and Our Earth	Unit 3 – Energy and Our Universe	Unit 4 – Biology and Our Environment
3. Energy, electricity and radiations				
a. energy transfers can be measured and their efficiency calculated, which is important in considering the economic costs and environmental effects of energy use	E explore the importance of energy stores, energy transfers and energy transformations			
b. electrical power is readily transferred and controlled, and can be used in a range of different situations			B know how electrical energy produced from different sources can be transferred through electric circuits to homes and industry	
c. radiations, including ionising radiations, can transfer energy	F explore the properties and applications of waves in the electromagnetic spectrum		A understand ionising radiation, its uses and sources	
d. radiations in the form of waves can be used for communication	F explore the properties and applications of waves in the electromagnetic spectrum			

Science KS4 programme of study	Unit 1 – Principles of Science	Unit 2 – Chemistry and Our Earth	Unit 3 – Energy and Our Universe	Unit 4 – Biology and Our Environment
4. Environment, Earth and Universe				
a. the effects of human activity on the environment can be assessed using living and nonliving indicators				B demonstrate an understanding of the effects of human activity on the environment and how these effects can be measured
b. the surface and the atmosphere of the Earth have changed since the Earth's origin and are changing at present		D understand the factors that are affecting the Earth and its environment		
c. the solar system is part of the universe, which has changed since its origin and continues to show long-term changes			C know the components of the Solar System, the way the Universe is changing and the methods we use to explore space	

Annexe F

The periodic table of the elements

The Periodic Table of the Elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

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						

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.

October 2017

For more information on Pearson and BTEC qualifications please visit our websites: qualifications.pearson.com and www.btec.co.uk

Pearson Education Limited. Registered in England and Wales No. 872828
Registered Office: 80 Strand, London WC2R 0RL. VAT Reg No GB 278 537121