edexcel

Edexcel BTEC Level 1 Award/ Certificate/Diploma in Applied Science (QCF)

Specification

First teaching September 2010

Issue 2

ALWAYS LEARNING PEARSON

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All information in this specification is correct at time of publication.

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Publications Code FL033244

Contents

Purpose of this specification

The purpose of a specification as defined by Ofqual is to set out:

- the qualification's objective
- any other qualification which a learner must have completed before taking the qualification
- any prior knowledge, skills or understanding which 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 which a learner must have satisfied before the learner will be assessed or before the qualification will be awarded
- the knowledge, skills and understanding which 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
- any specified levels of attainment.

1 Introducing BTEC Specialist qualifications

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

What are BTEC Specialist qualifications?

BTEC Specialist qualifications are qualifications from Entry to level 3 on the Qualifications and Credit Framework (QCF). They are work-related qualifications and are available in a range of sectors. They give learners the knowledge, understanding and skills they need to prepare for employment. They also provide career development opportunities for those already in work. These qualifications may be full time or part time courses in schools or colleges. Training centres and employers may also offer these qualifications.

Some BTEC Specialist qualifications are knowledge components in Apprenticeship Frameworks ie Technical Certificates.

There are three sizes of BTEC specialist qualification in the QCF:

- Award (1 to 12 credits)
- Certificate (13 to 36 credits)
- Diploma (37 credits and above).

Every unit and qualification in the QCF has a credit value.

The credit value of a unit is based on:

- one credit for every 10 hours of learning time
- learning time – defined as the time taken by learners at the level of the unit, on average, to complete the learning outcomes to the standard determined by the assessment criteria.

2 Qualification summary and key information

Qualification title	Edexcel BTEC Level 1 Award in Applied Science (QCF)
QCF Qualification Number (QN)	501/0074/9
Qualification framework	Qualifications and Credit Framework (QCF)
Date registrations can be made	1st September 2010
Age range that the qualification is approved for	14-16 16-18 19+
Credit value	6
Assessment	Centre-devised assessment (internal assessment)
Guided learning hours	60
Grading information	The qualification and units are at pass grade.
Entry requirements	No prior knowledge, understanding, skills or qualifications are required before learners register for this qualification. However, centres must follow the Edexcel Access and Recruitment policy (see *Section 10, Access and recruitment*)

Qualification title	Edexcel BTEC Level 1 Certificate in Applied Science (QCF)
QCF Qualification Number (QN)	501/0075/0
Qualification framework	Qualifications and Credit Framework (QCF)
Date registrations can be made	1st September 2010
Age range that the qualification is approved for	14-16 16-18 19+
Credit value	13
Assessment	Centre-devised assessment (internal assessment)
Guided learning hours	110
Grading information	The qualification and units are at pass grade.
Entry requirements	No prior knowledge, understanding, skills or qualifications are required before learners register for this qualification. However, centres must follow the Edexcel Access and Recruitment policy (see *Section 10, Access and recruitment*)

Qualification title	Edexcel BTEC Level 1 Diploma in Applied Science (QCF)
QCF Qualification Number (QN)	501/0073/7
Qualification framework	Qualifications and Credit Framework (QCF)
Date registrations can be made	1st September 2010
Age range that the qualification is approved for	14-16 16-18 19+
Credit value	37
Assessment	Centre-devised assessment (internal assessment)
Guided learning hours	310-350
Grading information	The qualification and units are at pass grade.
Entry requirements	No prior knowledge, understanding, skills or qualifications are required before learners register for this qualification. However, centres must follow the Edexcel Access and Recruitment policy (see *Section 10, Access and recruitment*)

QCF qualification title and Qualification Number

Centres will need to use the QCF Qualification Number (QN) when they seek public funding for their learners. As well as a QN, each unit within a qualification has a QCF unit reference number (URN).

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 *Edexcel Information Manual* on our website at www.edexcel.com

Objective of the qualifications

The Edexcel BTEC Level 1 Award/Certificate/Diploma qualifications in Applied Science (QCF) have been developed in the science sector to:

- provide full-time learners aged 14-16 with an Applied Science qualification that covers the How Science Works criteria. A mapping document is provided, (*Annexe E*).
- provide full-time learners aged 14-16 with an Applied Science qualification that covers the Key Stage 4 Programme of Study for Science. Centres can cover the Key Stage 4 Science criteria by delivering *Unit 4: Skills and Techniques for Chemistry Investigations*, *Unit 5: The Study of Living Systems* and *Unit 6: The Nature and Applications of Energy, Waves and Radiation*. A mapping document is provided (*Annexe F*).
- provide full-time learners with an opportunity to gain an appropriate vocational qualification prior to entering employment in the science sector as a science technician or assistant practitioner
- enable learners to consider their relationship with the scientific community and their interaction with the community
- provide opportunities for learners to engage in learning which is relevant to them and will provide opportunities to develop a range of skills, techniques, personal skills and attributes essential for successful performance in working life
- provide opportunities for learners to achieve a nationally recognised level 1 vocationally specific qualification
- enable full-time learners to progress to vocational qualifications such as the Edexcel BTEC Level 2 Diploma in Applied Science or progress to related general and/or other vocational qualifications.

Edexcel BTEC Level 1 Award (QCF) (6 credits)

The 6-credit Edexcel BTEC Level 1 Award (QCF) provides an introduction to the skills, qualities and knowledge that may be required for employment in a particular vocational sector.

Edexcel BTEC Level 1 Certificate (QCF) (13 credits)

The 13-credit Edexcel BTEC Level 1 BTEC Certificate (QCF) extends the work-related focus from the Edexcel BTEC Level 1 Award (QCF) and covers some of the knowledge and practical skills required for a particular vocational sector.

The Edexcel BTEC Level 1 Certificate (QCF) offers an engaging programme for those who are clear about the vocational area that they wish to learn more about. These learners may wish to extend their programme through the study of a related GCSE, a complementary NVQ or other related vocational or personal and social development qualification. These learning programmes can be developed to allow learners to study complementary qualifications without duplication of content.

For adult learners the Edexcel BTEC Level 1 Certificate (QCF) can extend their knowledge and understanding of work in a particular sector. It is a suitable qualification for those wishing to change career or move into a particular area of employment following a career break.

Edexcel BTEC Level 1 Diploma (QCF) (37 credits)

The 37-credit Edexcel BTEC Level 1 Diploma (QCF) extends the work-related focus from the Edexcel BTEC Level 1 Certificate (QCF). There is potential for the qualification to prepare learners for employment in a particular vocational sector and it is suitable for those who have decided that they wish to enter a specific area of work.

Progression opportunities through Edexcel qualifications

The intended destinations for learners successfully achieving these qualifications include:

- GCSEs and/or A levels
- Diplomas
- apprenticeships
- supported employment
- independent living.

Industry support and recognition

These qualifications are supported by the SSB and the SSC.

3 Centre resource requirements

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

General resource requirements

- Centres must have appropriate physical resources (for example, equipment, IT, learning materials, teaching rooms) to support the delivery and assessment of the qualifications.
- Staff involved in the assessment process must have relevant expertise and occupational experience.
- There must be systems in place to make sure continuing professional development for staff delivering the qualifications.
- Centres must have appropriate health and safety policies in place relating to the use of equipment by learners.
- Centres must deliver the qualifications in accordance with current equality legislation.

Specific resource requirements

As well as the general requirements above, there are specific resource requirements that centres must meet:

Unit	Resources required
Unit 1: Starting Work in the Science Sector	Information can be obtained from employers, chambers of commerce, local careers officers, careers library, job centre, recruitment agencies, newspapers, specialist magazines and training providers.
Unit 2: Working in the Science Sector	Use of guest speakers and visits to science organisations would enhance delivery of this unit.
Unit 3: Using Equipment to Make Scientific Observations and Measurements	Learners require access to an appropriate range of equipment and materials to carry out measurements and observations during practical work and to take measurements in the field. Access to a laboratory would be advantageous.
Unit 4: Skills and Techniques for Chemistry Investigations	Learners will need access to a chemistry/science laboratory equipped with a fume cupboard and standard laboratory chemistry apparatus. Access to a range of information resources to complete investigative assignments and case studies will be essential, including relevant CD ROMs and the internet.

Unit	Resources required
Unit 5: The Study of Living Systems	Learners should have access to a range of biology resources, similar to those used for GCSE Science. Learners will also need access to a biology/science laboratory. Access to a range of information resources to complete investigative assignments and case studies is essential, including relevant CD ROMs and the internet.
Unit 6: The Nature and Applications of Energy, Waves and Radiation	Learners will need access to a laboratory equipped with an appropriate range of equipment and materials to carry out measurements and observations during practical work.
Unit 7: Growing Plants for Commercial Use	Learners require access to a range of biology resources, similar to those used for GCSE Science. They will need access to a biology/science laboratory equipped with standard laboratory chemistry apparatus. It would also be helpful if learners had access to a greenhouse or outdoor area for growing, although small-scale work could be undertaken on windowsills or benches near windows.
Unit 8: Causes of Disease and Maintaining Health	Learners can find information from scientific journals, magazines, websites and newspapers. Learners should have access to a range of biological/health science resources, similar to those used for GCSE Science. Access to a range of information resources to complete investigative assignments and case studies will be essential, including relevant CD ROMs and the internet.
Unit 9: Forensic Detection	It is essential that learners have access to a range of information resources to complete investigative assignments and case studies, including a variety of books, journals, internet sites, CD ROMs and DVDs. Learners should also have access to a range of biology, chemistry and physics resources, similar to those used for GCSEs in Science. Learners will need access to a science laboratory equipped with a fume cupboard and standard laboratory apparatus.
Unit 10: Healthy Living	Learners will need access to appropriate, up-to-date information on healthy living guidelines from a range of agencies. They will also need access to physical resources to support their chosen practical activities and appropriate tutor support and guidance.

Unit	Resources required
Unit 11: Making and Testing Cosmetic Products	Visits to a beauty salon or cosmetics manufacturer are strongly recommended. Basic equipment and suitable premises for making and testing cosmetic products are essential for this unit. Access to a fully equipped basic science laboratory would be advantageous, but it is possible to make cosmetic products with only a small range of equipment. The main requirements are as follows: • safety equipment (safety glasses, protective clothing, gloves etc) • heating equipment • basic glassware (test tubes, beakers, stirring rods, measuring cylinders, thermometers, filter funnels) • accurate scales or chemical balance • microscope and slides • ingredients for making chosen cosmetic products • suitable containers (lipstick cases, hollow pencils for eyeliner, small jars with lids and eye shadow compacts can be purchased from the same suppliers as basic ingredients) • common solvents, indicator papers, filter paper.
Unit 12: Practical Scientific Project	Access to library and internet data is essential, in addition to sufficient laboratory time to allow learners to carry out their chosen practical investigations. The choice of investigation will be negotiated with the tutor but it must be practically based. Access to computers to facilitate production of project reports is desirable. Where available, science and mathematics packages could be used to help learners present their data in the most appropriate way. Suitably experienced and qualified staff will be needed to supervise the practical work and the assessments carried out in the laboratory.
Unit 13: Making Useful Scientific Devices	Learners require access to a laboratory equipped with an appropriate range of tools and materials to construct and test their scientific devices.

Unit	Resources required
Unit 14: Using Mathematical Tools in Science	Using mathematical tools is an essential part of any science technician's work. To deliver this unit the centre will need to provide laboratory space equipped for Level 2 work. Learners will need the facilities to carry out practical work so the technical expertise required at this level can be practised and demonstrated. This will include carrying out practical experiments that allow for the application of the mathematical skills covered in the unit. Access to scientific calculators, computers, CD ROMs and the internet is also essential. The computers need to have packages for plotting graphs etc. Access to mathematical tutorial packages would be an advantage.
Unit 15: Science in the World	Access to library and internet data is essential, but laboratory space is not required. Relevant journals, daily papers, weeklies and periodicals either in hard copy or on the internet are essential. Access to television channels via cable and satellite would be useful, especially for 24-hour news and other topical programmes including any specialising in science topics. Colleagues from within the teaching centre and/or outside speakers with a knowledge of the media, sociology, politics, law, economics, morals and ethics are valuable contributors to this unit. The use of tutors from these backgrounds would help the science assessor to get a full picture of the work presented by learners. Depending on what kind of presentation the learner wants to use, access to recording equipment might be needed.

4 Qualification structures

Edexcel BTEC Level 1 Award in Applied Science (QCF)

The learner will need to meet the requirements outlined in the table below before Edexcel can award the qualification.

Minimum number of credits that must be achieved	6
Minimum number of credits that must be achieved at level 1 or above	4

Unit	Unique Reference Number	Optional units	Level	Credit	Guided Learning Hours
1	H/600/5401	Starting Work in the Science Sector	1	2	20
2	D/600/5915	Working in the Science Sector	1	2	20
3	D/600/5929	Using Equipment to Make Scientific Observations and Measurements	1	4	40
4	F/600/5941	Skills and Techniques for Chemistry Investigations*	1	4	40
5	H/600/5950	The Study of Living Systems*	1	4	40
6	F/600/5986	The Nature and Applications of Energy, Waves and Radiation*	1	4	40
7	Y/600/5959	Growing Plants for Commercial Use	1	4	40
8	M/600/5966	Causes of Disease and Maintaining Health	1	4	40
9	L/600/3951	Forensic Detection	1	4	40
10	F/502/0476	Healthy Living	1	2	20
11	A/600/5985	Making and Testing Cosmetic Products	1	4	40
12	A/502/5000	Practical Scientific Project	2	5	30
13	K/601/4732	Making Useful Scientific Devices	1	2	20
14	M/502/5009	Using Mathematical Tools in Science	2	5	30
15	J/502/5016	Science in the World	2	5	30

*Pre-16 learners who are studying the BTEC Level 1 Award in Applied Science (QCF) can cover the Key Stage 4 programme of study for Science by completing Unit 4, Unit 5 and Unit 6.

Edexcel BTEC Level 1 Certificate in Applied Science (QCF)

The learner will need to meet the requirements outlined in the table below before Edexcel can award the qualification.

Minimum number of credits that must be achieved	13
Minimum number of credits that must be achieved at level 1 or above	7

Unit	Unique Reference Number	Optional units	Level	Credit	Guided Learning Hours
1	H/600/5401	Starting Work in the Science Sector	1	2	20
2	D/600/5915	Working in the Science Sector	1	2	20
3	D/600/5929	Using Equipment to Make Scientific Observations and Measurements	1	4	40
4	F/600/5941	Skills and Techniques for Chemistry Investigations*	1	4	40
5	H/600/5950	The Study of Living Systems*	1	4	40
6	F/600/5986	The Nature and Applications of Energy, Waves and Radiation*	1	4	40
7	Y/600/5959	Growing Plants for Commercial Use	1	4	40
8	M/600/5966	Causes of Disease and Maintaining Health	1	4	40
9	L/600/3951	Forensic Detection	1	4	40
10	F/502/0476	Healthy Living	1	2	20
11	A/600/5985	Making and Testing Cosmetic Products	1	4	40
12	A/502/5000	Practical Scientific Project	2	5	30
13	K/601/4732	Making Useful Scientific Devices	1	2	20
14	M/502/5009	Using Mathematical Tools in Science	2	5	30
15	J/502/5016	Science in the World	2	5	30

*Pre-16 learners who are studying the BTEC Level 1 Award in Applied Science (QCF) can cover the Key Stage 4 programme of study for Science by completing Unit 4, Unit 5 and Unit 6.

Edexcel BTEC Level 1 Diploma in Applied Science (QCF)

The learner will need to meet the requirements outlined in the table below before Edexcel can award the qualification.

Minimum number of credits that must be achieved	37
Minimum number of credits that must be achieved at level 1 or above	20

Unit	Unique Reference Number	Optional units	Level	Credit	Guided Learning Hours
1	H/600/5401	Starting Work in the Science Sector	1	2	20
2	D/600/5915	Working in the Science Sector	1	2	20
3	D/600/5929	Using Equipment to Make Scientific Observations and Measurements	1	4	40
4	F/600/5941	Skills and Techniques for Chemistry Investigations*	1	4	40
5	H/600/5950	The Study of Living Systems*	1	4	40
6	F/600/5986	The Nature and Applications of Energy, Waves and Radiation*	1	4	40
7	Y/600/5959	Growing Plants for Commercial Use	1	4	40
8	M/600/5966	Causes of Disease and Maintaining Health	1	4	40
9	L/600/3951	Forensic Detection	1	4	40
10	F/502/0476	Healthy Living	1	2	20
11	A/600/5985	Making and Testing Cosmetic Products	1	4	40
12	A/502/5000	Practical Scientific Project	2	5	30
13	K/601/4732	Making Useful Scientific Devices	1	2	20
14	M/502/5009	Using Mathematical Tools in Science	2	5	30
15	J/502/5016	Science in the World	2	5	30

*Pre-16 learners who are studying the BTEC Level 1 Award in Applied Science (QCF) can cover the Key Stage 4 programme of study for Science by completing Unit 4, Unit 5 and Unit 6.

5 Assessment

The table below gives a summary of the assessment methods used in the qualifications.

Units	Assessment methods
All units	Centre-devised assessment

Centre-devised assessment (internal assessment)

Each unit has specified learning outcomes and assessment criteria. To pass an internally assessed unit, learners must meet all the assessment criteria. Centres may find it helpful if learners index and reference their evidence to the relevant learning outcomes and assessment criteria.

Centres need to write assignment briefs for the learners to show what evidence is required. Assignment briefs should indicate clearly, which assessment criteria are being targeted.

Assignment briefs and evidence produced by learners must also meet any additional requirements in the *Information for tutors* section of the unit.

Unless otherwise indicated in *Information for tutors*, the centre can decide the form of assessment evidence (eg performance observation, presentations, projects, tests, extended writing) as long as the methods chosen allow learners to produce valid, sufficient and reliable evidence of meeting the assessment criteria.

Centres are encouraged to provide learners with realistic scenarios and maximise the use of practical activities in delivery and assessment.

To avoid over assessment centres are encouraged to link delivery and assessment across units. There is more guidance about internal assessment on our website. See *Section 13 - Further information and useful publications*.

6 Recognising prior learning and achievement

Recognition of Prior Learning

Recognition of Prior Learning (RPL) is a method of assessment (leading to the award of credit) that considers whether a learner can demonstrate that they can meet the assessment requirements for a unit through knowledge, understanding or skills they already possess and so do not need to develop through a course of learning.

Edexcel encourages centres to recognise learners' previous achievements and experiences in and outside the workplace, as well as in the classroom. RPL provides a route for the recognition of the achievements resulting from continuous learning.

RPL enables recognition of achievement from a range of activities using any valid assessment methodology. If the assessment requirements of a given unit or qualification have been met, the use of RPL is acceptable for accrediting a unit, units or a whole qualification. Evidence of learning must be sufficient, reliable and valid.

Further guidance is available in the policy document *Recognition of Prior Learning Policy*, which is on the Edexcel website.

Credit transfer

Credit transfer describes the process of using a credit or credits awarded in the context of a different qualification or awarded by a different awarding organisation towards the achievement requirements of another qualification. All awarding organisations recognise the credits awarded by all other awarding organisations that operate within the QCF.

If learners achieve units with other awarding organisations, they do not need to retake any assessment for the same units. The centre must keep evidence of unit achievement.

7 Centre recognition and approval

Centres that have not previously offered Edexcel qualifications need to apply for, and be granted, centre recognition as part of the process for approval to offer individual qualifications. New centres must complete an *Edexcel Vocational Centre & Qualification Approval Form (VCQA)*.

Existing centres get 'automatic approval' for a new qualification if they are already approved for a qualification that is being replaced by the new qualification and the conditions for automatic approval are met. Centres that already hold Edexcel Centre approval are able to apply for qualification approval for a different level or different sector via Edexcel Online, up to and including level 3 only.

In some circumstances, qualification approval using Edexcel Online may not be possible. In such cases, guidance is available as to how an approval application may be made.

Approvals agreement

All centres are required to enter into an approval agreement that is a formal commitment by the head or principal of a centre to meet all the requirements of the specification and any associated codes, conditions or regulations. Edexcel will act to protect the integrity of the awarding of qualifications. If centres do not comply with the agreement, this could result in the suspension of certification or withdrawal of approval.

8 Quality assurance of centres

Quality assurance is at the heart of vocational qualifications. The centre assesses Edexcel BTEC qualifications. The centre will use quality assurance to make sure that their managers, internal verifiers and assessors are standardised and supported. Edexcel use quality assurance to check that all centres are working to national standards. It gives us the opportunity to identify and provide support, if needed, to safeguard certification. It also allows us to recognise and support good practice.

For the qualifications in this specification, the Edexcel quality assurance model will follow one of the processes listed below.

1 Delivery of the qualification as part of a BTEC apprenticeship ('single click' registration):

- an annual visit by a Standards Verifier to review centre-wide quality assurance systems and sampling of internal verification and assessor decisions

2 Delivery of the qualification outside the apprenticeship:

- an annual visit to the centre by a Centre Quality Reviewer to review centre-wide quality assurance systems
- Lead Internal Verifier accreditation. This involves online training and standardisation of Lead Internal Verifiers using our OSCA platform, accessed via Edexcel Online. Please note that not all qualifications will include Lead Internal Verifier accreditation. Where this is the case, we will annually allocate annually a Standards Verifier to conduct postal sampling of internal verification and assessor decisions for the Principal Subject Area.

For further details, go to the *UK BTEC Quality Assurance Handbook* on our website.

9 Programme delivery

Centres are free to offer the qualifications using any mode of delivery (for example full time, part time, evening only, distance learning) that meets their learners' needs. Whichever mode of delivery is used, centres must make sure that learners have access to the resources identified in the specification and to the subject specialists delivering the units.

Those planning the programme should aim to enhance the vocational nature of the qualification by:

- liaising with employers to make sure a course is relevant to learners' specific needs
- accessing and using non-confidential data and documents from learners' workplaces
- developing up-to-date and relevant teaching materials that make use of scenarios that are relevant to the sector
- giving learners the opportunity to apply their learning in practical activities
- including sponsoring employers in the delivery of the programme and, where appropriate, in the assessment
- making full use of the variety of experience of work and life that learners bring to the programme.

Centres must make sure that any legislation is up to date and current.

10 Access and recruitment

Edexcel's 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.

Centres are required to recruit learners to BTEC specialist qualifications with integrity.

Applicants will need relevant information and advice about the qualification to make sure it meets their needs.

Centres should review the applicant's prior qualifications and/or experience, considering 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 teaching and assessment of the qualification. The review must take account of the information and guidance in *Section 11 Access to qualifications for learners with disabilities or specific needs*.

Learners may be aged between 14 and 16 and therefore potentially vulnerable. Where learners are required to spend time and be assessed in work settings, it is the centre's responsibility to ensure that the work environment they go into is safe.

11 Access to qualifications for learners with disabilities or specific needs

Equality and fairness are central to our work. Edexcel's Equality Policy requires all learners to have equal opportunity to access our qualifications and assessments. It also requires our qualifications to be 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 from undertaking a qualification and that this achievement can be compared fairly to the achievement of their peers.

Learners taking a qualification may be assessed in British sign language or Irish sign language where it is permitted for the purpose of reasonable adjustments.

Details on how to make adjustments for learners with protected characteristics are given in the policy documents *Application of Reasonable Adjustment for BTEC and Edexcel NVQ Qualifications* and *Application for Special Consideration: BTEC and Edexcel NVQ Qualifications*.

The documents are on our website at www.edexcel.com/policies

12 Units

Units have the following sections.

Unit title

The unit title is on the QCF and this form of words will appear on the learner's Notification of Performance (NOP).

Unit reference number

Each unit is assigned a unit reference number that appears with the unit title on the Register of Regulated Qualifications.

QCF level

All units and qualifications within the QCF have a level assigned to them. There are nine levels of achievement, from Entry to level 8. The QCF Level Descriptors inform the allocation of the level.

Credit value

When a learner achieves a unit, they gain the specified number of credits.

Guided learning hours

Guided learning hours are the times when a tutor, trainer or facilitator is present to give specific guidance towards the learning aim for a programme. This definition covers lectures, tutorials and supervised study in for example open learning centres and learning workshops. It also includes assessment by staff where learners are present. It does not include time spent by staff marking assignments or homework where the learner is not present.

Unit aim

This gives a summary of what the unit aims to do.

Essential resources

- This section lists any specialist resources needed to deliver the unit. The centre will be asked to make sure that these resources are in place when it seeks approval from Edexcel to offer the qualification.

Learning outcomes

Learning outcomes of a unit set out what a learner knows, understands or is able to do as the result of a process of learning.

Assessment criteria

Assessment criteria specify the standard required by the learner to achieve each learning outcome.

Unit amplification

This section clarifies what a learner needs to know to achieve a learning outcome.

Information for tutors

This section gives tutors information on delivery and assessment. It contains the following subsections.

- *Delivery* – explains the content's relationship to the learning outcomes and offers guidance on possible approaches to delivery.
- *Assessment* – gives information about the evidence that learners must produce, together with any additional guidance if appropriate. This section should be read in conjunction with the assessment criteria.
- *Indicative resource materials* – lists resource materials that can be used to support the teaching of the unit, for example books, journals and websites.

Unit 1: Starting Work in the Science Sector

Unit reference number: H/600/5401

QCF level: 1

Credit value: 2

Guided learning hours: 20

Unit aim

This unit enables learners to develop an awareness of the different types of jobs available in the science sector. They will also explore the skills and personal qualities that such jobs require.

Unit introduction

In this unit learners will explore the requirements for starting work in the science sector which offers a wide range of job opportunities.

Learners will find out about organisations that use science such as hospital trusts, plastic, glass, cement or paint manufacturers, and forensic science services. These organisations usually have at least one department focusing on science, for example an analytical laboratory, research laboratory or plant nursery.

There is a wide range of job roles for people employed in science-based organisations. Learners will explore the scientific activities of local organisations and examine available jobs.

Learners will investigate the skills and personal qualities needed for employment in the science sector. These include the ability to follow health and safety procedures.

Essential resources

Information can be obtained from employers, chambers of commerce, local careers officers, careers library, job centre, recruitment agencies, newspapers, specialist magazines and training providers.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Know about different types of jobs within the science sector	1.1	describe types of organisations that use science	□ *Types of organisation*: types eg private business, public sector, education and training, leisure
		1.2	compare and contrast the scientific activities of local organisations	□ *Activity of organisation*: scientific activities eg health, education, pharmaceutical, biotechnology, genetic engineering, cosmetics, beauty therapy, food, fine and bulk chemicals, petroleum, plastics, textiles, water, waste disposal
		1.3	describe two different job roles in the science sector	□ *Job roles*: types eg research, manufacture, testing, education □ *Job titles*: within the science sector eg laboratory technician, plant operator, assistant practitioner, research assistant, scientific writer, biomedical scientist, chemist, forensic scientist, environmental officer
2	Know about skills and qualities required for jobs in the science sector	2.1	describe specific skills and personal qualities needed for scientific job roles	□ *Skills*: for scientific job roles eg essential and desirable requirements, qualifications, experience, awareness of health and safety procedures □ *Personal qualities*: for scientific job roles eg punctuality, reliability, honesty, initiative, responsibility, communication skills, manual dexterity, ability to follow instructions

Information for tutors

Delivery

Learners should gain a general knowledge of the types of jobs available in the science sector. Exploration of further qualifications needed for progression to specific types of scientific employment should be encouraged.

Much of the work for this unit could be based on personal research by learners, for example, visits to a workplace where learners can interview people who are employed in the science sector in different job roles, either on a one-to-one or on a group basis. Alternatively, guest speakers could be invited. Learners could contact professional bodies and employers about careers. They should be encouraged to look for science jobs in newspapers and journals.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

To achieve learning outcome 1, learners must describe four different types of organisation in the science sector. They must also compare and contrast the scientific activities of two local organisations and describe two different scientific job roles. This could be evidenced as a presentation or a poster/leaflet.

To achieve learning outcome 2, learners must describe specific skills and personal qualities needed for science jobs. This could be evidenced as a report, a presentation or a poster/leaflet. Learners could relate their findings to a job that appeals to them.

Suggested resources

Websites

Association for Science Education	www.ase.org.uk
Association of the British Pharmaceutical Industry	http://www.abpischools.org.uk/page/careers.cfm
Biochemical Society	www.biochemistry.org
Excellence Gateway	www.excellencegateway.org.uk
The Forensic Science Society	http://www.forensic-science-society.org.uk/Careers
GlaxoSmithKline	www.gsk.com/careers
Institute for Education Business Excellence	www.iebe.org.uk
Institute of Biomedical Science	www.ibms.org
Institute of Physics	www.iop.org
The Institution of Environmental Sciences -	http://www.ies-uk.org.uk/
New Scientist	http://jobs.newscientist.com/

Royal Society of Chemistry	www.rsc.org
Sector Skills Council for Science, Engineering and Manufacturing Technologies	www.semta.org.uk
Science, Technology, Engineering and Mathematics (STEM) -	http://www.stemnet.org.uk/
Society of Biology	www.societyofbiology.org

Unit 2: Working in the Science Sector

Unit reference number: D/600/5915

QCF level: 1

Credit value: 2

Guided learning hours: 20

Unit aim

This unit enables learners to develop an understanding of the terms and conditions of jobs in the science sector and procedures for monitoring employee performance. Learners will also explore the relationship between job choices and lifestyle.

Unit introduction

This unit helps learners to prepare for employability in industries which have a substantial scientific dimension to their activities. It will enable learners to find out more about what to expect when they start work in the science sector, and some of the things that apply specifically to working in this sector. Learners will be given the opportunity to explore the terms and conditions of different jobs.

Learners will also have the opportunity to find out how achievement and performance are monitored in the workplace.

Finally, learners will consider how work in the science sector could affect their lifestyle and strategies for managing their work/life balance.

Essential resources

Use of guest speakers and visits to science organisations would enhance delivery of this unit.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Understand the terms and conditions of jobs in the science sector	1.1	compare the terms and conditions of two jobs in the science sector	□ *Job type*: types eg part-time, full-time, temporary, seasonal, permanent, freelance, skilled, unskilled, operative, supervisory □ *Accessing terms and conditions*: contract of employment; staff handbook; public notices □ *Terms and conditions*: salary eg hourly, monthly, annually; work patterns eg hours of work, shift patterns, flexitime, annual leave; holidays eg annual leave, public holidays, maternity, paternity; benefits eg pensions, health schemes, meals, staff facilities; codes of practice eg clothing
		1.2	discuss procedures for monitoring employee performance	□ *Procedures for monitoring performance*: supervision eg coaching, mentoring, supervision; assessment eg line manager, peer assessment, self assessment; appraisal eg purpose, timing, methods
2	Know the relationships between job choices and lifestyle	2.1	describe how jobs can affect lifestyle and suggest management strategies	□ *Location of organisation*: geographical position eg urban, rural, regional variations; accessibility eg distance, availability of transport, cost □ *Work-life balance*: job choices eg full-time, part-time, temporary, shift patterns, night work, starting and finishing times, holidays, weekend working, childcare □ *Effects on lifestyle*: effects eg leisure time, family responsibilities, opportunities for study □ *Management strategies*: time management eg balancing domestic responsibilities, social life and opportunities for study; organisational eg opportunities for health and wellbeing; psychological eg stress management

Information for tutors

Delivery

This unit has been designed to encourage learners to think about what it is like to work in jobs within the science sector. Learners may have preconceptions and notions of work that the unit could help to clarify, as well as being encouraged to explore the types of work that might be available to them at this stage in their learning.

Learning outcome 1 focuses on the terms and conditions for working in the science sector. Guest speakers may be invited to share their experiences of the real work situation. They could describe their work patterns, benefits, job roles etc. Visits to science organisations may also help learners gain a better understanding of working in this sector. Learners could also access information from the internet. Small groups could focus on a particular job. They could use job advertisements as a source of information on pay, work patterns, benefits and conditions. The group could then present their findings to other groups. Learners must compare the terms and conditions of two different jobs.

Learners must also discuss procedures for monitoring employee performance. This could be achieved by interviewing different people about their jobs, for example by designing a questionnaire. An employee who has experienced the appraisal system could be invited to talk about their experiences. Role play may also be used to develop learners' understanding of assessment and appraisal.

For learning outcome 2, learners should consider their existing lifestyle, which could be achieved by keeping a diary for three weeks. This could then be used as a basis to describe how different jobs could affect their lifestyle and increase awareness of how they could adapt to work successfully in the science sector.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

To achieve learning outcome 1, learners must compare the terms and conditions for two jobs in the science sector. They must also discuss procedures for monitoring employee performance. Assessment evidence could be in the form of a report or presentation.

To achieve learning outcome 2, learners must describe how jobs in the science sector can affect lifestyle and management strategies. This could be presented as a report, a presentation or a mind map.

Suggested resources

Information can be obtained from employers, chambers of commerce, local careers officers, careers library, job centre, recruitment agencies, newspapers, specialist magazines, training providers.

Websites

Association for Science Education	www.ase.org.uk
Association of the British Pharmaceutical Industry	http://www.abpischools.org.uk/page/careers.cfm
Biochemical Society	www.biochemistry.org
Excellence Gateway	www.excellencegateway.org.uk
The Forensic Science Society	http://www.forensic-science-society.org.uk/Careers
GlaxoSmithKline	www.gsk.com/careers
Institute for Education Business Excellence	www.iebe.org.uk
Institute of Biomedical Science	www.ibms.org
Institute of Physics	www.iop.org
The Institution of Environmental Sciences -	http://www.ies-uk.org.uk/
New Scientist	http://jobs.newscientist.com/
Royal Society of Chemistry	www.rsc.org
Sector Skills Council for Science, Engineering and Manufacturing Technologies	www.semta.org.uk
Society of Biology	www.societyofbiology.org

Unit 3: Using Equipment to Make Scientific Observations and Measurements

Unit reference number: D/600/5929

QCF level: 1

Credit value: 4

Guided learning hours: 40

Unit aim

The aim of this unit is to give learners the knowledge, skills and understanding required to make observations and measurements in order to undertake scientific explorations safely and effectively.

Unit introduction

Employees working in practical scientific occupations need to know how to make safe use of a wide variety of scientific equipment for observation and measurement purposes in laboratories, workplaces or field studies. These skills are essential to provide accurate qualitative and quantitative information which will form the basis for scientific investigation with the aim of reaching conclusions and informing decision making.

This unit will enable learners to become familiar with a range of accessible observation and measurement scenarios and techniques. They will become familiar with the key characteristics of some of the most commonly used equipment, along with the correct use of some technical and scientific terminology. Learners will have the opportunity to make both qualitative and quantitative observations and measurements in a variety of practical situations. The unit gives learners the opportunity to develop knowledge, skills and understanding which will provide a foundation for progression and employment in industries associated with scientific activity.

Tutors may find it effective to deliver this unit alongside another which provides meaningful opportunities for observation and measurement, for example *Unit 9: Forensic Detection*.

Essential resources

Learners require access to an appropriate range of equipment and materials to carry out measurements and observations during practical work and to take measurements in the field. Access to a laboratory would be advantageous.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Know the types of observations and measurements in scientific investigations	1.1	identify types of measurements and their units	□ *Measurement*: types eg weight, length, volume, time; units eg millimetres, centimetres, metres, kilometres, millilitres, litres, grams, kilograms, hours, minutes, seconds; measurement abbreviations; accuracy eg to nearest gram, within 5 seconds, to two decimal places □ *Calculations*: average; percentage; maximum (longest, biggest, heaviest, fastest); minimum (shortest, smallest, lightest, slowest)
		1.2	identify types of scientific observation	□ *Observation*: types eg field, laboratory, short observations over a single session or during a day, long observations over a number of days; basic concept of hypothesis; predicted outcome
2	Know equipment needed for basic scientific observations and measurements	2.1	list the equipment needed for basic scientific observations and measurements	□ *Equipment*: types eg microscope, scales, thermometer, rulers, stopwatch, beakers, measuring cylinders, burettes, pipettes, Bunsen burners, test tubes, clamps, tripod □ *Measurements*: using different equipment eg setting up a microscope and slide, taking measurements from a thermometer, rule, pipette
3	Be able to make accurate scientific observations and measurements in given situations	3.1	predict outcomes of scientific observations and measurements in given situations	□ *Observations*: make and record scientific observations accurately
		3.2	use appropriate equipment safely to make scientific observations and measurements in given situations	□ *Health and safety*: health and safety requirements eg Personal Protective Equipment (PPE), removal of inappropriate garments and belongings, centre policies and procedures

Learning outcomes		Assessment criteria		Unit amplification
		3.3	record observations and measurements accurately from given situations	□ *Measurements*: predict possible outcomes; use equipment to take and record accurate measurements; draw conclusions from analysed results; use calculations; present results to an appropriate degree of accuracy □ *Materials*: types eg acids, alkalis, liquids, gases, solids; safe handling of materials
		3.4	present conclusions from given situations	□ *Results*: presentation eg tables, charts, drawings, specimens, photographs, products; methods eg verbal, written, electronic; comparison with hypothesis/predictions; conclusions eg interpret simple patterns in experimental results; perform simple calculations eg obtain averages, totals, maximum, minimum
		3.5	compare conclusions from scientific observations and measurements for given situations against predictions	

Information for tutors

Delivery

This practical unit has been designed to introduce learners to key elements of scientific investigation. The unit does not require access to a formal laboratory but it would be advantageous.

It is essential that learners are introduced to some basic scientific concepts, such as the 'setting of a hypothesis' and working principles such as health and safety at work.

The overall aim of the unit is to introduce learners, many of whom will have little or no prior scientific background, to scientific methods of investigation and reasoning. It also introduces the use of scientific observation and measurement to test how/why/what/will questions. It is therefore important that this unit is delivered in a manner designed to promote the interest and relevance of science while laying the foundations for progression.

All the activities can either be undertaken individually or as part of a group. Each learner could be encouraged to build their own portfolio of scientific experiments. It may then be appropriate to use this evidence against the assessment criteria for the unit.

Learners should be given the opportunity to participate in a range of scientific investigations, for example they may wish to explore why it is that a given mass of ice floats, or they may set up a series of tests with an environmental theme to evaluate the effectiveness of various forms of insulation and their cost-effectiveness. The precise nature of the investigation is less important than the accessibility of the scenario as a means of developing knowledge, skills and understanding. Scenarios suggested to learners should engage them in meaningful observation and measurement.

Learners will also benefit from talks by guest speakers or visits to scientific establishments.

Assessment

To achieve learning outcome 1, learners must identify types of measurements and their units and identify types of scientific observation. A series of practical tasks and/or experiments could be used as assessment evidence, supported by assessor observation records.

To achieve learning outcome 2, learners must list the purpose of different pieces of equipment needed for basic scientific observations and measurements. Learner practical demonstrations could be used as assessment evidence, supported by assessor observation records. Assessment is best integrated with the practical tasks completed for learning outcome 1.

Learning outcome 3 deals with making predictions, observations and measurements and presenting conclusions. It also covers the importance of health and safety during practical investigations. Learners need to demonstrate their skills and ability to make accurate scientific measurements and observations, accurately recording their observations and data. They need to present the information in a relevant format using the correct units and draw logical, valid conclusions. This can be evidenced through assessor observations of learners carrying out practical work, supported by appropriate observation records.

Suggested resources

Books

Hutchings K, Bertin I and Osborne C – *Classical Chemistry Experiments* (The Royal Society of Chemistry, 2000) ISBN 9780854049196

Sykit S – *Signs, Symbols and Systematics* (ASE, 2000) ISBN 9780863573125

Websites

Focus Educational Software Ltd	www.focuseducational.com
Sector Skills Council for Science, Engineering and Manufacturing Technologies	www.semta.org.uk

Unit 4: Skills and Techniques for Chemistry Investigations

Unit reference number: F/600/5941

QCF level: 1

Credit value: 4

Guided learning hours: 40

Unit aim

The aim of this unit is to develop learners' knowledge and understanding of some of the fundamental concepts in chemistry. Learners will also be able to prepare useful chemical products.

Unit introduction

In this unit learners will cover some of the fundamental topics in chemistry, including extraction of raw materials from the Earth and its atmosphere, classification, properties of materials, chemical reactions and the factors that affect chemical reactions.

It is also important that learners have knowledge of the applications of chemistry such as uses for sustainable development, waste disposal, and pollution, their effects on the environment and society.

Learners will develop skills in the safe handling of laboratory apparatus, observation and measurement. Learners will also develop the necessary skills and techniques to safely follow laboratory procedures and processes, carry out risk analyses and use correct scientific symbols and terminology.

Essential resources

Learners will need access to a chemistry/science laboratory equipped with a fume cupboard and standard laboratory chemistry apparatus. Access to a range of information resources to complete investigative assignments and case studies will be essential, including relevant CD ROMs and the internet.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Understand how chemical elements are classified	1.1	identify elements 1 to 10 in the periodic table	□ *The periodic table*: symbols; metals; non-metals; groups and periods □ *Atomic particles*: atoms; molecules and ions □ *Atomic structure*: electrons; protons and neutrons; electronic shells for the first 10 elements; relationship to the elements in groups 1, 7 and 8 and their properties
		1.2	classify elements 1 to 10 in the periodic table	
		1.3	compare simple ionic and covalent materials	□ *Bonding*: covalent and ionic bonding eg hydrogen, chlorine, carbon, methane, water, sodium chloride; properties of covalent and ionic materials
2	Know the main factors involved in chemical reactions	2.1	construct simple chemical equations	□ *Chemical changes*: starting material(s); chemical change; product(s) eg decomposition, neutralisation, dehydration and hydration, oxidation □ *Equations*: word equations; simple balanced equations □ *Chemical products and useful properties*: types eg acids, alkalis, fertilisers, baking powder, plastics, fireworks, sodium carbonate, cement, plaster, smart materials, nanochemicals
		2.2	describe the factors affecting chemical changes	□ *Factors involved in chemical changes*: reaction rates eg concentration, temperature, catalyst, surface area; endothermic and exothermic reactions, increase and decrease in temperature

Learning outcomes		Assessment criteria		Unit amplification
3	Know how to identify useful natural resources for use as potential future fuels	3.1	identify useful natural resources from the Earth and its atmosphere, and their applications	□ *Extraction and application*: obtaining and using starting materials from natural resources eg oxygen, helium, oil, coal, natural gas, metal ore □ *Environmental and sustainable*: issues eg effects on the Earth's atmosphere, global warming, fossil fuels, disposal and recycling □ *Natural activity*: effects on the Earth's crust and its atmosphere from natural causes eg volcanoes, earthquakes
		3.2	identify future fuels and their applications	□ *Future chemical fuels*: hydrogen; ethanol from biomass; fuel cells
4	Be able to create useful chemical products from given starting materials	4.1	create useful chemical products safely, following guidelines	□ *Chemical products*: types eg soap, hand cream, glue, plastics, synthetic fibres □ *Health and safety*: risk assessment; personal and protective equipment; safety procedures; emergency procedures

Information for tutors

Delivery

The purpose of this unit is to develop learners' knowledge of some of the concepts underlying chemistry, along with the applications of chemistry to manufacturing and service industries. Delivery strategies should reflect the nature of work within the science sector by using an assignment/portfolio-building approach where learners take responsibility for their own learning and develop their practical investigative skills.

For learning outcome 1, learners need to know the importance of the periodic table and the classification of chemical elements. Simple models can be used to show how molecules are represented. Models should also be used wherever possible to help demonstrate the properties of bonded substances.

In learning outcome 2, delivery needs to focus on learners' knowledge of the importance of types and patterns of chemical reactions producing new substances and altering the properties of new and existing substances.

Learning outcome 3 addresses the importance of extracting and using materials from the Earth and its atmosphere. It also addresses the environmental effects of using these materials, their disposal, recycling and sustainability. This is an important outcome where learners can discuss their own lifestyles and how they affect the environment and sustainable development.

Visiting speakers from the chemical industry or visits/placements to the industry would be useful to place concepts in a vocational setting.

Learners should be given the opportunity to carry out a number of formative developmental activities. Activities could include:

- using the periodic table to classify elements into groups, periods and metals/non-metals
- investigating the atomic structure of a selection of elements and their associated shells
- experiments to investigate the properties of simple covalent and ionic substances
- experiments to investigate chemical changes and the factors that affect them
- investigating useful chemical products and their relevant properties
- investigating the effects of human activity on the environment and sustainable development.

Learning outcome 4 gives learners the opportunity to create useful chemical products, whilst also demonstrating their ability to work safely in laboratory conditions.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

The assessment strategies used in this unit need to reflect the evidence requirements for the assessment criteria and should use scientific investigative assignments, where communication can be considered through the learners' presentations, scientific laboratory reports, posters, graphs, charts etc.

To achieve learning outcome 1, learners will need to present evidence showing that they can identify a number of elements, including gases, minerals and metals and how they are classified within the periodic table. This could be evidenced via an ICT-based presentation, or wall chart/poster presentation.

Learning outcome 2 focuses on how chemicals can react with each other, and the factors involved in generating or regulating these reactions. Assessment evidence could be generated through assessor observation of learners conducting simple experiments to investigate chemical changes and the factors that affect them, supported by question and answer sessions.

To achieve learning outcome 3, learners need to be able to identify natural resources and possible future fuels. Assessment evidence could be presented as reports, posters or leaflets.

Learning outcome 4 could be evidenced through observations of learners carrying out practical work. Learners should demonstrate their ability to create chemical products, following guidelines. They must also demonstrate their ability to work safely.

Suggested resources

Books

Goodfellow D, Hocking S and Musa I - *BTEC First Principles of Applied Science Student Book*, Pearson Education, 2012 (ISBN 978-1-4469-0279-0)

Hutchings K, Bertin I and Osborne C – *Classical Chemistry Experiments* (The Royal Society of Chemistry, 2000) ISBN 9780854049196

Levesley M, Johnson P, Jones M, Chapman C - *Edexcel GCSE Science : GCSE Science Student Book* (Pearson Education, 2011) ISBN 9781846908897

Ryan L – *Chemistry for You* (Nelson Thornes, 2001) ISBN 9780748762347

Sykit S – *Signs, Symbols and Systematics* (The ASE companion to 5 - 16 Science, 2000) ISBN 9780863573125

Twenty First Century Science: GCSE Chemistry Workbook (OUP Oxford, 2011) ISBN 978-0199138418

Websites

The Association for Science Education	http://www.ase.org.uk
BBC – GCSE Bitesize	http://www.bbc.co.uk/schools/gcsebitesize/science
Focus Educational Software Ltd	www.focuseducational.com
The Royal Society of Chemistry – Chemsoc	www.chemsoc.org
Sector Skills Council for Science, Engineering and Manufacturing Technologies	www.semta.org.uk

Unit 5: The Study of Living Systems

Unit reference number: H/600/5950

QCF level: 1

Credit value: 4

Guided learning hours: 40

Unit aim

This unit will develop learners' knowledge of basic cell structure. They will also study human interaction with the environment and the role of genes in inheritance.

Unit introduction

It is important that learners studying an applied science programme have a good knowledge of the basic concepts of biology that they can develop, and use, in a variety of applications.

This unit will enable learners to develop their biology practical skills and their underpinning knowledge and understanding of biology, including applications in the workplace and effects on the environment and society. The knowledge and skills developed are essential for technicians and assistant practitioners working in biology, healthcare, food science, agriculture, horticulture, beauty therapy and other biology-related industries and laboratory services.

It is important during the delivery and assessment of this unit that learners take on the role of (or work towards) being employed within the biology sector or within organisations that use biology.

Learners will investigate how body systems respond to internal and external environmental changes, using hormonal and nervous signals to maintain the body processes. Learners will gain an appreciation of how living organisms interact with each other and their surroundings. They will also gain an awareness of how organisms adapt to their environment.

Essential resources

Learners should have access to a range of biology resources, similar to those used for GCSE Science. Learners will also need access to a biology/science laboratory.

Access to a range of information resources to complete investigative assignments and case studies is essential, including relevant CD ROMs and the internet.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Know that cells are the building blocks of life which form tissues and carry out vital functions	1.1	identify major organelles of eukaryotic cells	□ *Cells*: major organelles of eukaryotic cells; nucleus, cytoplasm, cell membrane □ *Specialised cells*: red blood cells; nerve; sperm
		1.2	describe the role of the nervous system in homeostasis	□ *Homeostasis*: nervous system; endocrine system; feedback mechanisms; response to internal and external stimuli
		1.3	describe the role of the endocrine system in homeostasis	
2	Know the interactions within environments	2.1	describe components of an ecosystem	□ *Definitions*: ecosystems; habitat; population; community; species; food webs; food chains
		2.2	explain adaptations in ecosystems	□ *Adaptations*: evolution; environment eg deserts, cold regions, volcanic environment; competition eg food, space, predator and prey relationships
		2.3	describe the effects of humans on ecosystems	□ *Effects of humans on ecosystems*: effects eg pesticides and insecticides on plants and animals, carbon emissions, human population, acid rain; living and non-living indicator assessment
3	Know the role of genes in inheritance and variation	3.1	describe the role of genes in inheritance	□ *Inheritance*: genes; chromosomes; allele; dominant recessive; mutations causing variations that lead to evolutionary change □ *Human health*: inherited diseases eg Huntingdon's chorea, haemophilia, cystic fibrosis
		3.2	describe the role of genes in variation	□ *Variation*: height; eye colour; sex

Information for tutors

Delivery

This unit can be delivered through a programme of tuition and practical investigative work. This will enable learners to develop skills and learn the fundamental concepts needed to develop further in the biological sciences sector.

In learning outcome 1 learners study the structure of cells. Where possible this should be carried out practically by observing cell slides under microscopes and making illustrations of observations. Learners should be able to compare and contrast different cells and recognise that these differences may show distinct characteristics by which cells may be distinguished or grouped together. Learners need only be familiar with the term 'cells with a nucleus' (not 'eukaryotic').

Learners also need to be familiar with the term 'homeostasis' and the role of the nervous and endocrine systems in maintaining a balanced internal environment.

Learning outcome 2 enables learners to explore ecosystems and living things in their environment, for example how animals can adapt to their environment. Learners will also study how human activity can effect and change the environment. This learning outcome could be delivered through relevant field trips.

Learning outcome 3 covers inheritance and the function of chromosomes and genes. Learners will study how mutations can influence the development of an organism, leading to evolutionary change. For example, the growth in numbers of the melanic form of peppered moth *Biston Betularia* in the industrial north of England towards the end of the nineteenth century. Learning outcome 3 also covers the effects of inheritance on human health and the role of genes in human variation.

Learners can carry out a number of formative developmental activities including:

- the structure and function of cells and specialised cells
- the role of the nervous and endocrine systems in homeostasis
- ecosystems and their dynamics
- the adaptations of animals
- predator and prey relationships
- the impact of human activity on ecosystems and their inhabitants
- the effects of human activity on the environment
- genes and their functions
- variations – continuous and discontinuous
- environmental variations.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

Assessment evidence can be generated through a variety of means, for example the use of scientific investigative reports, presentations, posters, graphs, charts, photographs etc.

For learning outcome 1, learners must identify the major organelles of eukaryotic cells. Evidence could be generated via a report or a presentation. Learners would not be expected to know the terminology 'eukaryotic'.

Learners also need to be familiar with the term 'homeostasis' and need to describe the role of the nervous and endocrine systems in maintaining a constant internal environment.

For learning outcome 2, learners must describe the different components of an ecosystem. They need to explain adaptations in ecosystems, providing evidence and/or examples to support their views. Learners also need to describe the effects of humans on ecosystems. This could be evidenced through practical investigations, reports or question and answer sessions with the assessor. Field trips and accompanying notes, would also be highly recommended.

For learning outcome 3, learners must describe the role of genes in inheritance and variation. The evidence for this could be an investigation into the roles of genes, with learners producing assessment evidence in the form of a report or presentation.

Suggested resources

Books

Goodfellow D, Hocking S and Musa I - *BTEC First Principles of Applied Science Student Book*, Pearson Education, 2012 (ISBN 978-1-4469-0279-0)

Levesley M, Johnson P, Jones M, Chapman C - *Edexcel GCSE Science : GCSE Science Student Book* (Pearson Education, 2011) ISBN 9781846908897

Twenty First Century Science: *GCSE Biology Workbook* (Oxford University Press, 2012) ISBN 9780199138364

Journals

Focus

New Scientist

Websites

BBC – GCSE Bitesize	http://www.bbc.co.uk/schools/gcsebitesize/science
Focus Educational Software Ltd	www.focuseducational.com
Genetic Alliance UK	www.gig.org.uk
The Association for Science Education	http://www.ase.org.uk
The Environment Agency	www.environment-agency.gov.uk
Teens Health – The Basics on Genes and Genetic Disorders	http://kidshealth.org/teen/your_body/health_basics/genes_genetic_disorders.html

Unit 6: The Nature and Applications of Energy, Waves and Radiation

Unit reference number: F/600/5986

QCF level: 1

Credit value: 4

Guided learning hours: 40

Unit aim

This unit gives learners the opportunity to find out about energy, waves, radiation and space exploration. They will also construct simple electric circuits and take electrical measurements.

Unit introduction

Physics has a wide range of applications both in everyday life and in the science laboratory. This unit develops learners' knowledge and understanding of some fundamental principles of physical science and enables them to apply these principles to a range of practical situations.

Electrical power is readily transferred and controlled, and is therefore used in many industrial, service and domestic devices. Technicians need to be familiar with basic electric circuits so that they can handle electrical equipment safely. Learners will have the opportunity to gain hands-on experience of using practical devices and test instruments.

Learners should appreciate that space programmes involve many scientific applications. For example, environmental monitoring and modern astronomy both involve remote sensing. Learners will have the opportunity to explore some of the instrumentation used, and appreciate the benefits that it brings.

Learners will develop relevant practical skills required by employees who work in the science sector.

The way in which this unit is delivered and assessed allows learners to experience applied physical science in authentic contexts.

Essential resources

Learners will need access to a laboratory equipped with an appropriate range of equipment and materials to carry out measurements and observations during practical work.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Know the importance of energy stores and energy transfers	1.1	identify energy stores and energy transfers	□ *Energy stores and energy transfers*: chemical eg fuel and oxygen; kinetic (in a moving object); gravitational (due to the position of an object in a gravitational field); elastic eg in a stretched or compressed spring; thermal (in a warm object); mechanically (when a force moves through a distance); electrically; by heating (because of a temperature difference); by radiation eg light, microwaves, sound □ *Measuring energy transfers*: energy conservation; power; efficiency; economic costs; unit (Joule)
2	Know the applications of waves and radiation	2.1	list the different types of ionising radiation	□ *Ionising radiation*: types (alpha, beta and gamma, x-rays); effects on living cells; radiation dose; radiation protection procedures (using absorbers and distance, duration of exposure, irradiation versus contamination)
		2.2	identify the different types of electromagnetic waves and their applications	□ *Waves for communications and transferring energy*: radio waves; microwaves; infrared; visible light; communication range, speed, security □ *The electromagnetic spectrum*: radio, x-rays, gamma radiation, microwaves, visible spectrum; ionising and non-ionising; applications eg medical, heating, remote sensing of the Earth (surface temperatures, vegetation including crops)
3	Be able to take measurements in electric circuits	3.1	identify the components of simple electric circuits	□ *Basic circuit theory*: the need for a complete circuit; current (mA, A), voltage (mV, V); resistance (Ω); simple series and parallel circuits; use of ammeter, voltmeter, multimeter to take measurements □ *Power supplies*: types of battery eg rechargeable, non-rechargeable; solar cell; simple generators eg bicycle dynamo, rotating a coil in a permanent magnetic field
		3.2	use an ammeter and voltmeter to take electrical measurements	

Learning outcomes		Assessment criteria		Unit amplification
4	Know the methods used to explore space	4.1	describe the structure and dynamic nature of the universe	□ *Universe*: the structure and dynamic nature of the Universe (solar system, stars and galaxies, large-scale structure); looking back in time □ *Instrumentation*: optical and thermal infrared telescopes (reflecting, ground-based and satellite)
		4.2	identify methods used to investigate space	□ *Recent technologies*: robotics eg space probes; new materials eg heat and fire resistant materials; CCD detectors

Information for tutors

Delivery

The purpose of this unit is to develop in learners a knowledge of some of the underlying, physical concepts of science – energy, waves and radiation. Learners will explore the practical application of these through building simple electrical circuits and learning about the methods used in space exploration. Delivery strategies should reflect the nature of work within the science sector by using an assignment/portfolio building approach where learners start to take responsibility for their own learning and develop their practical investigative skills.

Learning outcome 1 introduces learners to different types of energy and how it can be stored and transformed, and the principle of energy conservation. Learners should be able to discuss energy stores and energy transfers. Learners will also know how to measure energy transfers, including using the unit for energy.

Learning outcome 2 focuses on learning about the types of ionising radiation and the different types of electromagnetic waves and their applications.

Learning outcome 3 introduces learners to simple electrical circuits. They will explore how to set up simple series and parallel circuits and measure the current and voltage. Calculations involving these measurements are not required.

For learning outcome 4, learners will find out about the structure of the universe and methods used to investigate space, focusing on the instrumentation used to collect data about space.

As far as possible the learning outcomes should be delivered using a practical, investigative approach that will enable learners to develop their practical and enquiry skills. Briefings for investigations should be based on scenarios applicable to an industrial laboratory or other organisation that routinely uses physical science applications. Visiting speakers, videos showing practitioners in the workplace or visits/placements to science-related workplaces can usefully place concepts in a vocational setting.

Suggested skills activity

Learners can carry out a number of formative developmental activities and assignments in order to prepare for summative assignments. Activities that learners could carry out can include:

- building model loudspeakers, microphones or motors that work
- experimenting virtually with radioactive sources and absorbers
- making a simple communication system based on a switch, power supply and remote indicator lamp; operating this communication system using an agreed code
- using an energy or power meter to measure the demand of a mains electrical appliance
- using information sources to research current developments in space science or satellite remote sensing of the Earth.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

Assessment evidence could be generated through the use of scientific investigative assignments, where communication can be considered through learners' presentations, scientific laboratory reports, graphs, charts etc.

To carry out the investigative work, learners will require a brief giving guidance about the necessary practical or case study/assignment work and ideas about how to obtain information to solve straightforward problems.

Suggested resources

Books

Goodfellow D, Hocking S and Musa I - *BTEC First Principles of Applied Science Student Book*, Pearson Education, 2012 (ISBN 978-1-4469-0279-0)

Levesley M, Johnson P, Jones M, Chapman C - *Edexcel GCSE Science : GCSE Science Student Book* (Pearson Education, 2011) ISBN 9781846908897

Twenty First Century Science: GCSE Physics Workbook (Oxford University Press, 2011) ISBN 9780199138463

Sykit S – *Signs, Symbols and Systematics* (The ASE companion to 5 - 16 Science, 2000) ISBN 9780863573125

Journals

Focus

New Scientist

Websites

The Association for Science Education	http://www.ase.org.uk
BBC – GCSE Bitesize	http://www.bbc.co.uk/schools/gcsebitesize/science
BBC Science and Nature: Space	www.bbc.co.uk/science/space
Crocodile clips	www.crocodile-clips.com
Faulkes Telescope Project	http://www.faulkes-telescope.com/
GCSE com	www.gcse.com/energy.htm
Hubble Space Telescope	www.hubblesite.org
NASA — living in space	www.nasa.gov/
National Schools' Observatory	www.schoolsobservatory.org.uk
Particle Physics and Astronomy	www.pparc.ac.uk/Ed/ps_intro.asp
Practical Physics	www.practicalphysics.org
RadiationLab	www.visualsimulations.co.uk

Unit 7: Growing Plants for Commercial Use

Unit reference number: Y/600/5959

QCF level: 1

Credit value: 4

Guided learning hours: 40

Unit aim

The unit gives learners the knowledge and skills needed to grow plants successfully. Learners will also learn how to measure the commercial success of plant growth.

Unit introduction

This unit aims to develop learners' understanding of the plant industry and of how to grow plants successfully. It is important that learners realise that growing plants is an important industry as plants are a source of a wide range of things including food, medicines, dyes, flavours and aromatic oils.

The unit develops learners' knowledge and the practical skills required to carry out successful plant experiments. To grow plants successfully learners must research and determine the conditions that aid optimal growth. Learners will be introduced to factors that affect plant growth and will explore ways in which to obtain optimum plant growth or yield.

Learners will investigate the conditions fundamental for successful growth of a variety of plant types, for example types of soil, water, pH, minerals, fertilisers, growth medium, pesticides, light and temperature. They will also consider the importance of organic techniques as a way of understanding the effects of commercial plant growth on the Earth and the environment, together with the views of society on these issues.

It is important during the delivery and assessment of this unit that learners understand the roles of employees working within the plant industry or organisations that use plant science. This can be achieved by carrying out assignments/activities within a workplace setting. Learners need to develop skills in the safe handling of laboratory apparatus and gardening equipment; observation and measurement; the ability to safely follow laboratory procedures and processes; recording, interpreting and analysing data; carrying out risk assessment and using correct symbols and terminology.

Essential resources

Learners require access to a range of biology resources, similar to those used for GCSE Science.

They will need access to a biology/science laboratory equipped with standard laboratory chemistry apparatus. It would also be helpful if learners had access to a greenhouse or outdoor area for growing, although small-scale work could be undertaken on windowsills or benches near windows.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Know the different conditions that allow plants to grow successfully	1.1	identify factors that affect plant growth	□ *Light, temperature and water*: the requirements for photosynthesis, importance of space for leaf and root growth without competition □ *Types of growth media*: different types of soil eg peat, lime, sandy, clay, loam, hydroponics □ *Soil air*: importance of worms, ploughing or digging □ *Effect of pH*: adding lime, manure or peat to alter soil characteristics □ *Fertilisers*: testing soil for nitrate, working out amount of fertiliser needed □ *Minerals*: importance of NPK, other minerals such as magnesium □ *Pesticides*: likely pests in the growth area, appreciation of biological control □ *Competition from weeds*: what weeds are, competition
2	Be able to grow a chosen plant under suitable conditions	2.1	select a chosen plant for growth	□ *Chosen plant*: the different optimal conditions and requirements for named, chosen plant growth; consider environmental implications, ie grown organically or not
		2.2	grow the chosen plant under suitable conditions	□ *Method of planting*: best method of growing chosen plant including consideration of costs and amount of light needed □ *Seeds*: time of year for planting; growth medium required; space needed; depth of planting; effect of late frosts; use of greenhouse or cloches □ *Weather forecast*: importance of avoiding frosts or very dry weather □ *Cuttings*: importance of hormone rooting powder; growth medium □ *Bulbs and tubers*: growth medium; depth of planting; space required □ *Care of plant*: water requirements of potted plants; control of pests; use of pesticide; use of greenhouse or cloches; regular weeding

Learning outcomes		Assessment criteria		Unit amplification
3	Be able to monitor the plant's growth	3.1	measure and record the plant's growth at appropriate intervals	□ *Height of plants*: regular measurements taken eg weekly or daily □ *Number of leaves*: regular counts □ *Dry mass*: as a measure of growth □ *Number of roots*: measurable in hydroponics methods □ *Health of plant*: colour of leaves (photographic evidence); evidence of pests; dryness of soil □ *Final yield*: yield eg mass of leaves, number of flowers, mass of roots, flavour of crop, aesthetics
		3.2	report what is shown by the evidence collected	□ *Data*: numerical or graphical data as a measure of the plant's growth; photographs
		3.3	suggest one improvement to the methods used for growing the plant	□ *Growth problems*: any problems identified during the monitoring process; suggestions for improvement
4	Know how to measure the commercial success of growing plants	4.1	identify the customer demand for the selected plant	□ *Customer demand*: knowing what the customer wants eg popular flower colour, favourite vegetable, appearance/taste of organic products
		4.2	identify the costs incurred when growing the plant commercially	□ *Cost*: costs versus value of product, ie cost-effectiveness; whether there is a market for the product □ *Simple charts or graphs*: to analyse data and to comment on any trends or patterns

Information for tutors

Delivery

The purpose of this unit is to develop learners' knowledge of some of the practical concepts involved in plant biology. The unit will show how applying this biological knowledge allows learners to optimise plant growth or yield, as in the manufacturing or 'service' plant biology industry.

Delivery strategies should reflect the nature of work within the plant science sector by using an assignment/portfolio-building approach where learners start to take responsibility for their own learning and develop their practical investigative skills. The knowledge gained about the factors affecting the growth of plants in learning outcomes 1 and 2 can then be applied to real-life applications through learning outcomes 3 and 4.

Learners need to know the importance of soil structure and composition, soil pH and the variety of minerals available in soil water. In addition, for learning outcome 1, learners need to be aware of the importance of water conservation (where necessary) and the principle of hydroponics. As well as monitoring growth for learning outcome 3, learners need to understand the importance of caring for plants during growth by dealing with both weeds and potential pests and diseases. This will include an appreciation of the importance of the weather and protecting crops from dry conditions or unexpected frosts. Learning outcome 4 requires learners to consider both the costs incurred and the potential market returns on the crop yield. This will relate to their market research. Learners should also include an aesthetic appreciation of the crop relating to, for example, flowers of a particular colour, or the flavour and appearance of vegetables.

Visiting speakers from the plant biology industry or visits/placements to market gardens, hydroponics centres, research centres or farms would be useful to place concepts in a vocational setting.

Suggested skills activity

Learners can carry out a number of formative developmental activities and assignments in order to prepare for summative assignments. Activities that learners could carry out include:

- using the internet to find out about conditions required for successful plant growth
- carrying out simple experiments on photosynthesis to demonstrate the importance of light, water and carbon dioxide
- investigating the structure of a seed and the requirements for germination
- carrying out simple experiments to show the main important parts of any plant and understand the economic importance of these parts
- carrying out a survey of soil nitrogen in different areas
- carrying out a survey to show the effects of pests and weeds on plant growth
- investigating the effects of pesticides or weedkillers on seed germination and plant growth
- investigating the effects of human activity on the environment as a result of commercial plant growth.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

Assessment evidence can be generated through the use of scientific investigative reports, presentations, posters, graphs, charts etc.

The assessment strategies used in learning outcomes 1, 2, 3 and 4 should address the need for learners to develop practical and investigative skills to collect, interpret and evaluate data to explain scientific theories. They should also cover the importance of health and safety and risk analysis during practical investigations, the validity/reliability of data and identification of errors.

The practical applications of plant biology need to be considered, wherever possible, throughout the unit and are focused mainly in learning outcomes 1 and 4. Learning outcomes 2 and 3 address learners' ability to use the information from learning outcome 1 and successfully grow a plant crop of their choice. This will involve using scientific skills for quantitatively monitoring and displaying the growth of their plant. Learners' practical tasks should be supported by assessor observation records to confirm the assessment criteria achieved.

Suggested resources

Books

Claybourne A, Ballard C, Silverman B and Lynette R – Growing Plants (Heinemann Library, 2008) ISBN 9780431111339

Hendy J - Gardening Projects for Kids: Fantastic Ideas for Making Things, Growing Plants and Flowers and Attracting Wildlife (Southwater, 2011) ISBN

Websites

British Tomato Growers' Association	www.britishtomatoes.co.uk
Friends of the Earth	www.foe.co.uk
Growell (Hydroponics advice and supplies)	www.growell.co.uk
Hydrohobby (Hydroponics supplier)	www.hydrohobby.co.uk
National Gardening Association Plant Care Guides	www.garden.org/plantguide
National Herb Centre	www.herbcentre.co.uk
National Trust	http://shop.nationaltrust.org.uk/
Soil Association	www.soilassociation.org

Unit 8: Causes of Disease and Maintaining Health

Unit reference number: M/600/5966

QCF level: 1

Credit value: 4

Guided learning hours: 40

Unit aim

This unit aims to give learners an understanding of the most significant factors which improve or harm health and an awareness of the causes of particular diseases.

Unit introduction

The unit explores questions about health and disease in a way that helps learners relate topics to themselves. Learners will investigate a range of factors affecting health and learn to recognise symptoms of disease. Learners will gain an awareness of common diseases and their causes. They will also examine a range of particular diseases which are prevalent in both the developed and the developing worlds and are of particular topical interest.

Understanding health and disease is important, not only in everyday life, but also in vocational settings. The awareness gained in this unit creates a platform for further study in all areas of science and paves the way towards careers in a wide variety of business and industrial settings. Without core knowledge of human health and disease, doctors could not diagnose and treat illnesses, pharmacists could not prescribe medications, and forensic scientists would be unable to investigate crimes successfully. In addition, business organisations in the private, public and voluntary sectors would fail to gain the most from their workforces.

On completion of this unit, learners will be able to recognise symptom profiles of common diseases, including some that are life threatening. They will also be able to identify factors contributing to ill health such as family history, diet, substance abuse and lifestyle choices. Learners will be able to make informed choices about their own lifestyles and gain a better understanding of public health campaigns presented in the media. Finally, they will develop a greater awareness of global health concerns such as communicable diseases in the developing world.

Essential resources

Learners can find information from scientific journals, magazines, websites and newspapers.

Learners should have access to a range of biological/health science resources, similar to those used for GCSE Science.

Access to a range of information resources to complete investigative assignments and case studies will be essential, including relevant CD ROMs and the internet.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Know what is meant by the terms 'health' and 'disease'	1.1	describe what is meant by health	□ *Health*: definitions of health eg negative, positive, holistic; subjective nature of health related to physical, mental, psychological, emotional and social needs
		1.2	identify different types of disease	□ *Disease*: communicable eg caused by bacteria, viruses, fungi, protozoa; non-communicable eg degenerative, deficiency, inherited, caused by lifestyle or the environment
2	Know factors that can affect the health of individuals	2.1	describe different factors that can affect the health of individuals	□ *Factors affecting health*: biological eg inherited, congenital; environmental eg air/water quality, arising from pollution and contamination; occupational eg exposure to toxins, repetitive strain injury; parasitic eg scabies, roundworms □ *Personal actions and choices*: lifestyle eg smoking, alcohol, drugs, inadequate exercise, inappropriate or unbalanced diet
3	Know the causes of disease	3.1	identify causes of different communicable diseases	□ *Infectious*: bacteria eg salmonella, tuberculosis; viruses eg common cold, influenza, HIV/AIDs; fungi eg athlete's foot, ringworm; protozoa eg malaria, sleeping sickness □ *Parasitic*: types eg scabies, roundworms
		3.2	identify causes of non-communicable diseases	□ *Non-infectious*: lifestyle choices eg smoking, substance misuse, fitness levels, diet; genetic eg predisposition to certain diseases, inherited diseases; environmental factors eg air/water pollution; occupational eg noise, asbestos; geographical eg rural/urban environment; socioeconomic eg access to appropriate nutrition, peer influences
		3.3	describe ways to limit the spread of disease	□ *Spread of disease*: methods to reduce spread eg personal hygiene, quarantine, developing immunity

Information for tutors

Delivery

This unit could be introduced by asking learners to work in small groups and discuss the meanings of the words 'health' and 'disease'. They could be encouraged to begin with what is familiar to them, and then build on this with, for example, the use of case studies or images to help them consider a range of different individual circumstances and needs. Learners could be encouraged to produce their own definitions of 'health' and then compare them as a group, followed by a comparison with, for example, the World Health Organization's definition. A survey of different definitions of health could also be carried out in the centre.

This can then lead to a consideration of the meaning of 'disease' with the use of relevant topical diseases to illustrate this. Small group presentations and class discussions could be used to aid understanding of the different types of disease. This understanding can then be extended, in the last section of the unit, by learners choosing which diseases they wish to study in more detail.

Historical examples such as the Industrial Revolution in England could be explored to help illustrate the topic. In some localities this could be achieved using museum visits, in others by showing video clips. Other activities that could be used to add relevance to this unit include, for example, a visit to a residential care home or a day centre. Learners could talk to older people about their experiences and ideas, broadening their own knowledge and insight. Such a visit would also give learners an insight into a social care environment, and the opportunity to practise interpersonal skills in a workplace. Learners would need to be carefully prepared before such a visit, possibly with a suggested list of appropriate questions to ask.

Factors that affect the health of individuals could be introduced through a case study approach. One possible vehicle could be to organise learners into small groups, ask them to idea storm the different factors and then produce a case study for the other groups to consider. This would introduce a range of factors, especially if each group was asked to focus on one or two particular factors, so that each had a different focus to its discussion.

Popular soap operas, television dramas and current news items could also be used, alongside class discussion, to consider factors affecting health. This could be used to introduce the topic in an interesting and impersonal way, though sensitivity will still be needed in the consideration of the various factors.

Learners can carry out a number of activities including using the internet to find out about different types of diseases and what causes them, and factors that influence the health of individuals in different environments.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

For assessment criterion 1.1, learners should use at least two examples to describe what is meant by the term 'health'. It is not sufficient for learners to copy definitions from a dictionary or internet website; research information must be applied. For assessment criterion 1.2, learners are required to identify examples of communicable and non-communicable diseases.

For assessment criterion 2.1, learners could design a poster or leaflet showing factors that may affect health. These may include positive and negative factors. Alternatively, learners could present information to the group following an investigation into different factors. Case studies could also be used to allow learners to demonstrate their knowledge of health factors and lifestyle choices.

Learning outcome 3 focuses on the causes of disease and how to limit the spread of disease. Learners could provide a short description of how the spread of disease may be limited. Alternatively they could carry out an investigation into ways in which diseases such as foot-and-mouth, and smallpox have been controlled. Articles from journals or internet sites may be a valuable source of information for this.

Suggested resources

Books

The Concise Human Body Book: An Illustrated Guide to Its Structure, Function and Disorders (Dorling Kindersley, 2009) ISBN 9781405340410

Goodfellow D, Hocking S and Musa I - *BTEC First Principles of Applied Science Student Book*, Pearson Education, 2012 (ISBN 978-1-4469-0279-0)

Wright D – *Human Physiology and Health* (Heinemann, 2000) ISBN 9780435633042

Websites

Best Health	www.besthealth.bmj.com
British Heart Foundation	www.bhf.org.uk
Department of Health	http://www.dh.gov.uk
Food Standards Agency	www.food.gov.uk
Genetic Alliance UK	www.gig.org.uk
National Institute for Health and Clinical Excellence	www.nice.org.uk

Unit 9: Forensic Detection

Unit reference number: L/600/3951

QCF Level: 1

Credit value: 4

Guided learning hours: 40

Unit aim

This unit aims to develop learners' skills, understanding and knowledge of scientific procedures by applying biological, chemical and physical analytical techniques to forensic science case studies.

Unit introduction

Scenes of Crime Officers (SOCO) work within the public service; they are officers who gather forensic evidence for the police service from crime scenes. In this unit learners are provided with the opportunity to learn about different types of biological, chemical and physical forensic evidence, how evidence is detected, collected and documented at the crime scene, and how to use scientific techniques to detect and identify evidence in the laboratory. Learners are also introduced to the role and responsibilities of the SOCO, the forensic scientist and the forensic science laboratory.

The unit should be largely practically based, and scenarios should be used to provide work-related forensic science detection experience and skills.

The unit introduces and develops the skills, understanding and knowledge of analytical scientific detection processes and their application to forensic science. The skills developed are essential for forensic science practitioners working in the forensic science workplace.

Essential resources

It is essential that learners have access to a range of information resources to complete investigative assignments and case studies, including a variety of books, journals, internet sites, CD ROMs and DVDs.

Learners should also have access to a range of biology, chemistry and physics resources, similar to those used for GCSEs in Science.

Learners will need access to a science laboratory equipped with a fume cupboard and standard laboratory apparatus.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Know roles and responsibilities of employees and laboratories in forensic detection	1.1	list roles and responsibilities of employees and laboratories involved in forensic detection	□ *Employees involved*: forensic detection eg forensic scientist, forensic analyst, scene of crime officer (SOCO), pathologist, toxicologist, odontologist, detective, police officer, archaeologist □ *Forensic scientist and scene of crime officer*: role; evidence reporting; expert witness; ethics; interviewing techniques □ *Forensic detection laboratories*: detection eg DNA, firearms, fingerprint and photographic units, Environmental Protection Agency, Food Standards Agency □ *Role of forensic detection laboratories*: analytical techniques; evidence and its interpretation; health and safety; operating procedures
2	Be able to recognise types of forensic evidence	2.1	recognise types of forensic evidence	□ *Biological evidence*: type eg fingerprints, hair, body fluids, DNA profiling, environmental profiling (soil, seeds, pollen, pollutants), entomology, odontology, archaeology □ *Physical evidence*: blood pattern analysis eg height, direction and angle; marks and impressions eg footprints, vehicle tyre prints, toolmarks, casting; electronic evidence eg computer crime, CCTV, mobile phone technology; document analysis eg handwriting, ink analysis □ *Chemical evidence*: toxicology eg drugs, alcohol, poisons, identification, weight and purity, body fluid tests; trace evidence eg fibres, glass, paint and ink, types, components, identification and comparison; types of firearms and bullets

Learning outcomes		Assessment criteria		Unit amplification
3	Be able to detect, record and collect evidence at the crime scene	3.1	follow given methods to detect forensic evidence	□ *Health and safety*: hazards and risks at the scene eg presence of suspect, biohazards, sharps □ *Scene and evidence*: personal protective equipment (PPE); securing the scene; searching for evidence; prevention of contamination □ *Recording and documenting*: measuring the scene and evidence; note taking; sketching; photography; video; collection, packaging and labelling
		3.2	follow given methods to record forensic evidence	
		3.3	follow given methods to collect forensic evidence	
4	Be able to demonstrate scientific procedures used to analyse and identify evidence	4.1	follow given scientific procedures used to analyse evidence	□ *Physical techniques*: size; melting point; boiling point; density; matching analysis; tyre and footprints □ *Scientific techniques*: type eg flame tests, microscopic analysis, colour tests, chromatography, colorimetry
		4.2	follow given scientific procedures used to identify evidence	

Information for tutors

Delivery

This unit is an introduction to scientific detection and the forensic science workplace. The purpose of the unit is to develop knowledge and skills in the underlying concepts of biological, physical and chemical analysis, applying them to forensic detection. The material contained in this unit should be introduced through a programme of tuition, guided learning and practical activities.

The unit should be delivered (wherever possible) using a practical investigative approach, to enable learners to develop their skills and understanding of the fundamental concepts developed in the area of forensic and analytical science. Delivery strategies should reflect the nature of the practical investigative work involved in the forensic science workplace by using applicable crime scenarios and case studies. The knowledge gained about the different types of evidence in learning outcome 2 can be applied to examples of applications in the crime scene in learning outcome 3 and to using analytical techniques in learning outcome 4. Learning outcome 1 should be referred to throughout the unit.

A range of teaching and learning methods can be used including:

- processing of a 'mock' crime scene
- industrial visits and guest speakers
- individual, pair and group practical investigations
- use of ICT to produce reports and analyse results
- use of internet sites and books for research
- group verbal presentations
- case study seminars
- trace evidence workshops
- class and group discussions
- interview and court role-play
- producing posters and information leaflets
- use of videos and DVDs.

Suggested skills activity

Learners should carry out a number of formative developmental activities and practical case scenarios in order to prepare for summative assignments.

The activities that learners could carry out include:

- using ink to record their fingerprints and determine the frequencies of patterns within the class population
- microscopic examination of different class members' hair
- simulated blood-typing activity available from commercial suppliers
- examination of a 'mock' burglary scene collecting different types of relevant evidence
- analysis of ink using chromatography

- analysis of 'spiked' drinks using colorimetry.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

The assessment strategies used in this unit need to reflect the evidence required for the assessment criteria. Forensic investigative practicals are highly recommended, where communication can be considered through learners' presentations, scientific laboratory reports, posters, graphs, etc.

The assessment strategies used should address the need for learners to develop practical and investigatory skills, and to collect, interpret and evaluate data to explain forensic detection. They should also cover the importance of health and safety during science investigations, the validity/reliability of data, interpretation of data, and quality and ethics in science. The applications of biology, chemistry and physics to forensic science need to be considered, wherever possible, throughout the unit.

To carry out the investigative work learners will require a brief which will guide them through the practical or case study/assignment work and give ideas about how to obtain information to solve straightforward problems.

Learners need to be able to follow simple scientific procedures, use scientific symbols, relevant terminology and identify errors.

Suggested resources

Books

Ballard C – *Collecting Crime Scene Evidence* (Forensic Science) (Franklin Watts, 2010) ISBN 9780749695002

Harris B, Kohlmeier K and Kiel R – *Crime Scene Investigation* (Libraries Unlimited, 1998) ISBN 9781563086373

Genge N E – *The Forensic Casebook: The Science of Crime Scene Investigation* (Ballantine, 2003) ISBN 9780345452030

Lyle D P – *Forensics for Dummies* (Hungry Minds, 2004) ISBN 9780764555800

Moore P – *The Forensics Handbook* (Eye Books, 2004) ISBN 9781903070352

Journals

Crime Magazine – an Encyclopaedia of Crime (www.crimemagazine.com)

Forensic Science International (Elsevier)

Journal of Forensic Sciences (ASTM International)

New Scientist

Science and Justice (Forensic Science Society)

Websites

Focus Educational Software Ltd	www.focuseducational.com
National Institute of Forensic Science Australia	http://www.nifs.com.au/
Shambles – Forensic Science	http://www.shambles.net/pages/learning/sciencep/forensic/

Unit 10: Healthy Living

Unit reference number: F/502/0476

QCF Level: 1

Credit value: 2

Guided learning hours: 20

Unit aim

To introduce learners to ways in which they can contribute to a healthy lifestyle and to encourage them to demonstrate activities which will improve their own lifestyle.

Unit introduction

This unit aims to develop the learner's knowledge and understanding of the key elements needed for a healthy lifestyle. Healthy living is crucial to physical, social and mental wellbeing.

There is considerable concern from governments and worldwide organisations that many people in modern society are living lifestyles that are detrimental to their health. It is therefore essential that learners are aware of the importance of a healthy lifestyle, their responsibility for their own lifestyle choices and the impact that this has on their own health.

In this unit learners will explore key issues such as healthy diet, fitness, personal hygiene, personal safety and the positive and negative effects they have on health. They will be encouraged to examine their own daily activities and demonstrate ways in which they can contribute to their own healthy lifestyle.

Learners will be given the opportunity to plan activities of their own choosing and reflect on the impact it has on the healthiness of their own way of living.

Completing this unit will contribute to learners' overall personal and social development and develop the skills and knowledge they need to make informed choices about healthy living. This understanding will help them to select activities that will improve the health of their lifestyle in the future and to educate and inform others.

Essential resources

Learners will need access to appropriate, up-to-date information on healthy living guidelines from a range of agencies. They will also need access to physical resources to support their chosen practical activities and appropriate tutor support and guidance.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Understand the importance of leading a healthy lifestyle	1.1	describe the key elements of a healthy lifestyle	□ *Key elements of a healthy lifestyle*: planning a healthy, well-balanced diet eg planning a day's healthy meals, the five major food groups and their uses in the body, reviewing a restaurant or refectory menu for healthy choices; taking routine care of own personal hygiene eg hair care, skin care, dental care; benefits of keeping fit eg heart health, keeping muscles and bones strong, keeping mobile into later life, social benefits; personal safety eg bullying/abuse, internet safety, safe sex; other elements of healthy living eg smoking, alcohol and drugs, solvent abuse
		1.2	explain why a healthy lifestyle is important	□ *Importance of a healthy lifestyle*: likely effects of a poor diet eg obesity, constipation, anaemia; possible personal hygiene problems eg body odour, bad breath; likely effects of poor level of fitness eg obesity, heart disease, poor mobility in later life; effects of substance abuse on health eg effects of smoking, glue sniffing, excessive consumption of alcohol; the importance of regular medical or dental checkups; knowing who to approach for help and advice eg doctor, practice nurse, pharmacist, counsellor, carer, telephone help lines
2	Demonstrate how they contribute to own healthy lifestyle	2.1	select and carry out activities which contribute to a healthy lifestyle	□ *Contributing to own healthy lifestyle*: making informed choices about health eg choosing whether to take drugs or drink alcohol, whether to cook own meals or buy 'fast foods'; knowing how and where to get reliable and accurate information about health issues; planning changes to own lifestyle taking into account realistic expectations, time, resources needed, cost, support needed; carrying out appropriate activities eg increasing the portions of fruit and vegetables eaten per day, walking to college or school twice a week for a month, playing a team sport once a week; how to get support with carrying out personal health plans eg classes available to help with healthy eating, groups providing free or low-cost exercise facilities, counselling for alcohol or drug abuse

Learning outcomes		Assessment criteria		Unit amplification
3	Review the activities undertaken to maintain a healthy lifestyle	3.1	carry out a review of their activities	□ *Reviewing own activities*: looking to see if the activities went according to plan, any changes or mistakes made, what could be done to improve the plan if it were repeated; measuring how the activities have improved lifestyle eg portions of fruit and vegetables eaten per day, units of alcohol consumed per week, feeling less tired, enjoyed playing sports; using the results of the activity to suggest future improvements to a healthy lifestyle
		3.2	describe what went well and areas for improvement	
		3.3	describe how the activities have improved their lifestyle	
		3.4	suggest further activities which could contribute to a healthy lifestyle	

Information for tutors

Delivery

This unit gives tutors the opportunity to use a wide range of active learning methods and to tailor them to the particular interests of the groups and individuals concerned. Tutors need to ensure that sufficient underpinning theoretical knowledge is delivered, however a tendency to become over-technical should be avoided. The focus should be on learners developing knowledge that helps them understand key aspects of healthy living and applying that knowledge to their own lifestyles and to the lifestyles of others.

In learning outcome 1 tutors should encourage learners to explore what is meant by a healthy lifestyle and identify particular factors that may be involved. There are many current popular TV shows dealing with aspects of diet which learners may be familiar with, these could be used to stimulate discussion and debate. Tutors will need to review the content and suitability of these shows taking into account the age, maturity and understanding of their particular learners.

Learners could be guided to appropriate websites on healthy eating, especially those with an interactive element. The larger supermarket chains often provide leaflets and other resources on healthy eating that learners could collect for reference. Keeping a food diary for a few days, examining the family weekly shopping list, or reviewing the menu in the refectory could help learners to focus on their own dietary habits. If suitable facilities are available, simple, practical food preparation activities could be planned and carried out and if not, learners could produce pictorial or written examples of healthy meals or menus.

Learners should be encouraged to recognise the relationship between diet and fitness, and how this relates to obesity. Many of the TV programmes, websites and resources chosen to stimulate discussion regarding diet, highlight this relationship. Learners could look at government and health-related organisations' advertising to identify current thinking on minimum levels of exercise.

Detailed theoretical knowledge is not necessary but learners should develop awareness that different types of exercise have different benefits, for example exercise that raises the heart rate is needed to strengthen the heart.

Personal hygiene will need to be addressed sensitively, taking into account cultural differences and personal circumstances. Learners could create posters, leaflets or cartoons depicting some of the issues. They could visit dental hygienists, doctors' surgeries or pharmacies to collect any relevant information available.

Visiting speakers on personal safety could be invited in from relevant bodies; for example local community police to talk about internet chat rooms or family planning professionals to talk about safe sex. Learners could act out sketches, carry out role-plays or write problem-page questions and answers illustrating the positive and negative effects on health of lifestyle choices, for example passive smoking or losing weight sensibly.

In learning outcome 2, learners can use activities they take part in outside of the learning environment or as part of other courses or units they are studying, for example Duke of Edinburgh Awards, sports clubs or teams, paid or voluntary work in a relevant environment or home responsibilities. They could use written, video or audio diaries to review their daily activities for impact on health. Tutors should encourage learners to use the resources and information they have gained in learning outcome 1 to identify simple changes they could make to improve their own lifestyles and ensure that any targets set are realistic in terms of time, cost and resources. Peers could support each other by checking each other's plans and monitoring progress.

In learning outcome 3, learners can be taught strategies to measure their own progress, for example by recording their resting pulse rate before, during and after a new programme of exercise or by comparing the number of portions of fruit and vegetables eaten each day. They could practise identifying what went well and what areas require improvement by reviewing the plans of their peers or exemplars.

Learners need to review how well the plan is executed as well as its impact on healthy living so that they will be able to meet assessment criteria 3.2 and 3.3 effectively.

Throughout the unit learners will be reflecting on aspects of their lives which may be very personal and therefore tutors will need to create a safe environment in which sensitive information can be shared.

Learners and tutors must agree clear guidelines regarding classroom behaviour that respects confidentiality, equality and diversity.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

To meet the requirements of assessment criterion 1.1, learners must include in their description information relating to diet, fitness, personal hygiene and personal safety. They may also include other aspects of a healthy lifestyle. Learners could meet 1.1 in a variety of ways, for example creating advice leaflets, creating a series of health promotion posters, responding to a case study or delivering a presentation.

Assessment criterion 1.2 could be achieved separately by means of individual questioning or a structured discussion group. However, it should fit naturally into the same assessment activity as 1.1. Learners should focus on the positive wherever possible, though it is acceptable for them to demonstrate understanding by explaining the negative effects of not having a healthy lifestyle, for example, 'If you eat a diet high in fats and sugars then you may become overweight and have a higher risk of suffering from diabetes and heart disease.'

To meet the requirements of assessment criterion 2.1, learners may receive guidance and support from the tutor in selecting suitable healthy living activities, this could include a list with a variety of suggestions. Tutors should not, however, direct learners to specific activities or give a prescriptive list from which learners must choose. A single activity is not sufficient to meet the criteria.

Learners could carry out a number of activities relating to different areas of the content, for example increasing the portions of fruit and vegetables eaten per day for a week, walking to college or school twice a week for a month and attending the dental surgery for a check up and advice from the dental hygienist. Alternatively, they could carry out a series of activities in the same area, for example aim to get fitter by walking, instead of catching the bus, three times a week, play a team sport once a week, go to the gym twice a week.

A minimum of two different activities is required. Evidence for 2.1 could be a completed written or photographic diary, assessor observation reports, witness statements or evidence from another recognised activity for example Duke of Edinburgh record book or signed record of attendance at a sports club.

The requirements for assessment criteria 3.1, 3.2, 3.3 and 3.4 could be incorporated into a single assessment activity alongside criterion 2.1. For example, the diary kept to evidence the activities carried out could include sections where learners record progress, what went well, areas for improvement as they go along, making a final summary and suggesting activities for further improvement at the end. Alternatively these could be addressed separately by means of a short presentation to the group or an individual discussion with the tutor, evidenced by assessor observation records.

Learners need to distinguish between assessment criterion 3.2, which refers to how well the chosen activities were carried out, for example 'I planned to attend the gym every day but this proved to be unrealistic' and criterion 3.3, which refers to the impact on their lifestyle eg 'I feel much less tired after exercise, than I did a month ago'. For assessment criterion 3.4, learners must give at least two suggestions for further activities.

Suggested resources

Websites

BBC health	www.bbc.co.uk/health/healthy_living/
British Dental Health Foundation	www.dentalhealth.org.uk/faqs/ browseleaflets.php
British Nutrition Foundation	www.nutrition.org.uk
Direct Gov – information and advice for work and careers	http://www.direct.gov.uk/en/YoungPeople/ Workandcareers/index.htm
Engauge	www.engaugeonline.co.uk
NHS Choices – Food and Diet	http://www.nhs.uk/livewell/goodfood/Pages/ Goodfoodhome.aspx
NHS Choices – Food Labelling	http://www.nhs.uk/Livewell/Goodfood/Pages /food-labelling.aspx
Herts Sports Partnership – health benefits of exercise	http://www.sportinherts.org.uk/index.php
Hygiene Expert	www.hygieneexpert.co.uk/ WhatIsPersonalHygiene.html
NHS Direct - Sexual health self-assessment	www.nhs.uk/Tools/Pages/ Safesextool.aspx

Unit 11: Making and Testing Cosmetic Products

Unit reference number: A/600/5985

QCF level: 1

Credit value: 4

Guided learning hours: 40

Unit aim

This unit will give learners opportunities to apply their knowledge and understanding of science to test and create cosmetic products.

Unit introduction

Cosmetic scientists and beauty therapists use and provide advice and information to customers about many types of cosmetic products including skincare preparations and colouring agents. This unit gives learners the opportunity to investigate cosmetics used in the beauty industry, their composition and the common ingredients used in their manufacture. It also gives them the opportunity to experiment with making simple cosmetic products and to carry out simple laboratory and consumer testing.

Learners will develop skills in handling laboratory apparatus, making observations and taking measurements. They will explore the application of underlying scientific principles and techniques and learn how to observe health and safety at work requirements and conduct risk assessments appropriately.

Essential resources

Visits to a beauty salon or cosmetics manufacturer are strongly recommended.

Basic equipment and suitable premises for making and testing cosmetic products are essential for this unit. Access to a fully equipped basic science laboratory would be advantageous, but it is possible to make cosmetic products with only a small range of equipment. The main requirements are as follows:

- safety equipment (safety glasses, protective clothing, gloves etc)
- heating equipment
- basic glassware (test tubes, beakers, stirring rods, measuring cylinders, thermometers, filter funnels)
- accurate scales or chemical balance
- microscope and slides

- ingredients for making chosen cosmetic products
- suitable containers (lipstick cases, hollow pencils for eyeliner, small jars with lids and eye shadow compacts can be purchased from the same suppliers as basic ingredients)
- common solvents, indicator papers, filter paper.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Know the types and uses of cosmetic products	1.1	describe the types and uses of cosmetic products	□ *Skincare products*: type eg lip balm, lipstick, facial masks, foundation, moisturiser, face wash, soaps, creams, aftershave, cleanser □ *Deodorants and antiperspirants*: types eg roll-on, cream, blocks, aerosols □ *Make-up products*: types eg lipstick, eyeliner, mascara, nail varnish, blusher, lip gloss, bronzer, face powder □ *Hair care products*: types eg hair gel, shampoos, conditioner, dyes, sprays, wax, lightener □ *Perfumes*: types eg sprays, roll-on, aerosols, concentrated, perfume, eau de toilette □ *Packaging and labelling*: ingredients; safety precautions; safety signs; recycling; instructions; effects and benefits; shelf-life
2	Understand the functions of key ingredients in cosmetic products	2.1	explain the role played by key ingredients in cosmetic products	□ *Dyes and pigments*: colouring agents □ *Oils, waxes and gels*: types eg beeswax, olive oil, coconut oil, protective barrier, moisturiser, skin softener, coating, conditioner, water retainer □ *Solvents*: types eg alcohols, water, dissolving agent, carrier/medium □ *Emulsifiers*: types eg gelatine, linoleic acid, suspension agent □ *Perfumes*: essential oils; mask smells; aroma □ *Preservatives*: antioxidants; stabilisers; extend shelf-life □ *Medical*: types eg anti-dandruff, UV filters (sun protection factors), antibacterial agents, antifungal agents □ *Soaps and shampoos*: salts of fatty acids; remove grease and dirt

Learning outcomes		Assessment criteria		Unit amplification
3	Be able to safely prepare cosmetic products	3.1	safely follow given instructions to demonstrate the preparation of cosmetic products	□ *Preparation of cosmetic products*: types eg soap, shampoo, lipstick, lip balm, foundation, deodorant, facial mask, hair conditioner, essential oil extracts □ *Health and safety*: risk assessments; safety precautions
4	Be able to safely test cosmetic products	4.1	safely follow given instructions to demonstrate safe testing of cosmetic products	□ *Testing of commercial and prepared products*: simple laboratory tests eg pH, cooling effect, chromatography, melting point, solubility, microscopic examination of emulsions □ *Scientific principles*: principles eg evaporation, solutions, suspensions, solvents, solubility, melting point, boiling point, acid, alkali, pH, saponification, hydrophilic, hydrophobic, colour, light, reflection

Information for tutors

Delivery

The purpose of this unit is to help learners develop their knowledge of some of the underlying concepts involved in science, applying these to the cosmetic manufacturing and service industries. Tutors should support learners as they take progressive responsibility for their own learning and develop their practical investigative skills, both individually and in teams.

For learning outcome 1, the knowledge gained about the types of cosmetic products will supplement the information about their uses. Learners could access information from given websites, apply to commercial organisations for information and gather information from beauty therapy salons. A talk from a beauty therapist, or a visit to a salon, would also be advantageous and would place underlying principles in a vocational setting.

Learners could be asked to identify safety labels and practise interpreting the contents of these labels used on cosmetic products in terms of their use, directions for use and their ingredients. This will tie in with learning outcome 2.

For learning outcome 2, delivery needs to focus on the learners' understanding of the importance of the ingredients of cosmetic products and their functions. This can include aspects such as the role of the solvent as a carrier for application of the main ingredient in aerosols or sprays and the role of the emulsifier in creams and gels to act as a suspension agent and also extend the life of the product. Activities could be carried out such as making some suspensions and observing the effect of adding an emulsifying agent.

For learning outcome 3, learners will be able to apply some of the knowledge they have gained in learning outcomes 1 and 2. This outcome addresses the importance of combining the correct ingredients when making cosmetic products and understanding the underlying scientific principles that give the products their desirable properties. For example, water-hating (hydrophobic) and water-loving (hydrophilic) substances and their role in emulsions.

Learners will have the opportunity to test commercial products and their own products in learning outcome 4. Activities that learners could carry out include investigations on measuring pH, for example using universal pH paper, examining suspensions under the microscope, making soap, and labels on cosmetic products. Additional activities could include chromatography of pigment, finding the melting point of lipstick, solubility of ingredients and preparing lip balm, hair gel, hair conditioner, deodorant or facial masks.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

The assessment strategies used in this unit need to reflect the evidence required and should use investigative activities where communication skills can be developed through learners' presentations. Assessment evidence could take the form of scientific laboratory reports, posters, graphs and charts.

Assessment strategies used should address the need for learners to develop practical and enquiry skills, and to use ICT to collect, interpret and evaluate data to explain scientific theories. They should also cover the importance of health and safety and risk analysis during practical investigations, the validity/reliability of data, and identification of errors.

The applications of science need to be considered wherever possible throughout the unit and particularly in learning outcomes 2 and 3. Learning outcomes 1 and 3 address examples of the useful applications and implications of science and technology.

To carry out investigative work, learners will require a brief which will guide them through the practical or case study/assignment work and give ideas about how to obtain information to solve straightforward problems.

Suggested resources

Books

Fraser R - *Neal's Yard Remedies Recipes for Natural Beauty* (Haldane Mason, 2007) ISBN 9781905339297

Khechara S – *The Holistic Beauty Book* (Green Books, 2008) ISBN 9781900322270

Tourles S – *Organic Body Care Recipes* (Storey Books, 2007) ISBN 9781580176767

Websites

Cosmetics, Toiletry and Perfumery Association	www.catie.org.uk
Somerset Cosmetics Company	www.makingcosmetics.com

Unit 12: Practical Scientific Project

Unit reference number: A/502/5000

QCF level: 2

Credit value: 5

Guided learning hours: 30

Unit aim

The aim of this unit is to allow learners to build on existing theories or practical work by conducting a practical science project related to their area of interest. The unit provides a natural investigative approach to extend their understanding and studies.

Unit introduction

This unit begins with learners choosing and planning an appropriate scientific project, including identifying risks and health and safety considerations. It is important that learners are given opportunities to explore and investigate areas of scientific theory they may have come across in their studies and that are possible within their own workplace. This does not need to be a piece of original work, however, learners should be given the opportunity to investigate areas of interest that excite and extend their own learning. Learners may be asked to carry out a practical investigation designed by somebody else or to suggest ways of carrying out an investigation themselves.

The scientific project is designed to allow learners to show their science knowledge and practical skills. After discussion with the tutor, learners will be asked to plan, carry out and analyse the results of their investigation and present it as a scientific report. They will record the activities they undertake during their project and monitor the progress of the project against the original plan they submit to their tutor. Learners will carry out research and apply it to the project outcomes, presenting them as a scientific report. They will then review the project, analysing information and drawing their own conclusions, and reviewing their own performance. Throughout the project it is important that clear communication skills and interpersonal skills are developed that enable learners to understand how the scientific community communicates with a wider audience.

This unit could be completed as part of a work placement. Examples of suitable projects would be investigating sound insulation, testing confectionery or a water garden. Ideally, the project will relate to learners' area of interest.

Essential resources

Access to library and internet data is essential, in addition to sufficient laboratory time to allow learners to carry out their chosen practical investigations. The choice of investigation will be negotiated with the tutor but it must be practically based.

Access to computers to facilitate production of project reports is desirable. Where available, science and mathematics packages could be used to help learners present their data in the most appropriate way.

Suitably experienced and qualified staff will be needed to supervise the practical work and the assessments carried out in the laboratory.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Be able to plan a practical scientific project	1.1	identify the health and safety risks associated with implementing this project	□ Health and safety: conduct appropriate risk assessment; elimination/minimisation of any health and safety risk in accordance with Health and Safety at Work Act 1974; Control of Substances Hazardous to Health (COSHH); risk assessment; Reporting of Injuries, Diseases and Dangerous Occurrences (RIDDOR); codes of practice; Good Laboratory Practice (GLP) and/or Good Manufacturing Practice (GMP) and/or Good Clinical Practice (GCP) as appropriate □ Information resources: identification, location and extraction of relevant information sources eg background reading, observations, previous investigations; record information sources as a resource list
		1.2	produce a project plan	□ Project plan: aim; scientific research and theory; hypothesis; resources/equipment needed; activities; milestones; health and safety risks; methodology (how to ensure accurate and valid results, how variables will be controlled)
2	Be able to use appropriate practical skills	2.1	assemble and use appropriate equipment safely to collect reliable scientific data	□ Experimental techniques: assembly of relevant equipment and materials; adherence to health and safety requirements; manipulative skills; appropriate use of instruments and techniques for taking measurements; observational skills
		2.2	record scientific data	□ Recording results: accuracy, integrity, maintenance of working laboratory log books and record keeping, Good Laboratory Practice (GLP), Good Manufacturing Practice (GMP), Good Clinical Practice (GCP), relevant legislation

Learning outcomes		Assessment criteria		Unit amplification
3	Be able to analyse and present results	3.1	analyse the scientific data obtained	□ Practical data: organisation of data eg class intervals, tallying; methods of data processing and analysis eg mean, standard deviation; correct units of experimental quantities used; assessment of experimental accuracy and precision; accurate calculations □ Validation of method and results: fitness for purpose of methods used; repeatability; sources and magnitude of errors in readings taken □ Scientific evaluation of findings: evaluation of results; sources of error and how to minimise; conclusions drawn using scientific principles; experimental and literature investigations; consideration of the hypothesis
		3.2	produce a scientific report	□ Scientific report of the investigation: correct scientific protocol eg structure, format; correct scientific language and terminology eg third person, past tense; inclusion of relevant references

Information for tutors

Delivery

Formal input will be needed at the start of or during this unit so that learners are clear about the scientific protocols associated with a science investigation. The investigation carried out by learners is not expected to be original but it should be new to them.

The choice of topic should be negotiated between learners and their tutor, with input where appropriate from other tutors or an employer. It is important that the tutor is able to support learners and guide them, where necessary, in selecting a project that has the potential to provide the learners with opportunities to meet all of the assessment objectives. A group project is also acceptable but each learner must produce their own, individual evidence.

Health and safety issues relating to this work must be emphasised and safe working practices adhered to. Risk assessments, the use of COSHH and other relevant regulations must be followed with learners supported by tutors to achieve this as necessary. Learners should be supervised by qualified members of staff in the laboratory and by other staff as appropriate to the topic of the project. If the project is being carried out as part of a work placement it is essential that a supervisor is present at all times when practical work is being carried out.

Having agreed an appropriate topic with their tutor, learners should then identify a question to be answered or purpose of the investigation. Tutorial support is likely to be needed to facilitate learners carrying out research, drawing up their hypothesis and planning the methods to be used for the practical investigation.

The tutor must observe each learner assemble the equipment needed and safely carry out the practical work.

A written report which follows standard scientific protocol will present the project, conclusions drawn and any subsequent evaluations or reviews. This can be supported with oral presentations as appropriate.

There are many possibilities as to suitable contexts for the projects. Using examples which relate to industry is encouraged, for example:

- confectionery plant
- milk quality control
- polymer production
- biotechnology organisation
- water quality control
- sports science
- beauty therapy
- textile manufacturer.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

Learners may require some assistance in finding information. The practical investigation should be fairly straightforward with clear boundaries for establishing success.

Learners should consider any health and safety risks which could be associated with the proposed project and practical investigation. They should provide evidence of having carried out risk assessments and of taking steps to remove or reduce such identified risks. Learners at this level are likely to require tutor support to enable them to complete risk assessments, with the level of support dependent on the complexity of the investigation being carried out.

Learners must produce a realistic working project plan which takes into account the risk assessments produced. The plan must clearly identify the aim of the investigation, any research necessary to allow completion of the project, an appropriate list of resources and equipment needed and an outline of the methodology. The plan should also incorporate a number of milestones or identified review points. Tutors should monitor individual learners' progress with their plans at appropriate intervals dependent on the complexity of the investigation.

It is expected that learners will have conducted some research using resources of their own choosing, although the tutor is able to provide support and guidance to help ensure research conducted is valid. A suitable method of recording resources used should be adopted. Learners will then utilise this researched information to help them draw up a hypothesis for their investigation. The relevant scientific theory must be clearly outlined.

Learners will be assessed performing the investigation in the laboratory. Learners must be observed as they assemble and use equipment and materials they need. Where tutors use tick sheets or any other list of factors to satisfy this assessment criterion, such a list must be shared with learners.

The recording of results and observations must be carried out through a working laboratory log (not on loose scraps of paper), following industry guidelines as appropriate, and should pay attention to suitable levels of accuracy and precision.

The practical data obtained should be organised, processed and analysed using methods suitable for the type of data collected. A qualitative approach is sufficient to meet this criterion but learners must show that they have analysed their results. Correct SI units (Système International d'Unités), should be used and calculations must be accurate with results that are clearly wrong being identified, checked and corrected.

Learners must draw together the results of their work, clearly stating conclusions drawn from the data they obtained during the practical investigation. The report should be produced using correct scientific protocol and all tables or diagrams should be correctly labelled.

Suggested resources

Books

Coyne G S – *The Laboratory Companion: A Practical Guide to Materials, Equipment, and Technique* (Wiley Blackwell, 2005) ISBN 9780471780861

Dean J R et al – *Practical Skills in Chemistry* (Prentice Hall, 2007) ISBN 9781405883085

Dean J R et al – *Practical Skills in Forensic Science* (Prentice Hall, 2007) ISBN 9781405883238

Jones A et al – *Practical Skills in Biology* (Prentice Hall, 2006) ISBN 9781405839747

Websites

Science Project Ideas	www.scienceprojectideas.co.uk

Unit 13: Making Useful Scientific Devices

Unit reference number: K/601/4732

QCF level: 1

Credit value: 2

Guided learning hours: 20

Unit aim

This unit enables learners to apply their scientific knowledge and develop practical skills by making two types of scientific devices and testing their effectiveness.

Unit introduction

The construction of simple devices to meet a need is common to all scientific disciplines. In this unit learners' practical skills are developed through constructing two scientific devices. Learners will need to develop skills in handling materials and simple tools, and the techniques to use them safely.

Learners will develop their ideas about calibration and accuracy through designing and making a simple balance to weigh small objects, and then testing its effectiveness. Accuracy is a vital part of a science technician's job and is also essential in various other industrial applications.

Learners will also develop an understanding of how electricity can be produced by making batteries safely, using available resources. They will then test the effectiveness of their batteries and develop an awareness of the harmful effects of batteries on the environment.

Essential resources

Learners require access to a laboratory equipped with an appropriate range of tools and materials to construct and test their scientific devices.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Be able to construct and test a weighing device	1.1	design a simple balance	□ *Types of balance*: types eg spring, elastic, lever □ *Design*: scientific terms eg weight, units of weight (gram), force, lever, fulcrum, counterweight; features eg mechanism, limits on weight, cost; properties of materials eg flexibility, stiffness, strength, ductility, malleability, brittleness
		1.2	construct and test the balance safely, using available resources	□ *Resources*: object to be weighed; materials eg cardboard, wood, metal, straw, plastic, paper □ *Testing*: calibration; accuracy; sensitivity; limitations
2	Be able to construct batteries to generate electricity	2.1	describe the components of a battery	□ *Components of a battery*: scientific terms (electron, electrode, conductor, voltage); construction (anode, cathode, electrolyte)
		2.2	construct and test batteries safely, using available resources	□ *Resources*: available resources eg oranges, lemons, apples, copper coin, lemon juice, copper sulfate solution, zinc sulfate solution, zinc rod, 2-inch strips of zinc, copper can, porous pot, connecting wire, crocodile clips, coarse sandpaper, cardboard, sellotape, elastic bands □ *Testing*: test eg voltmeter, multimeter, LED
		2.3	describe how batteries can harm the environment	□ *Effects on the environment:* harmful eg production, disposal

Information for tutors

Delivery

The purpose of this unit is to enhance learners' scientific understanding and practical skills in two different contexts. The unit will give learners an understanding of the importance of calibration when designing and constructing weighing equipment. Learners will also construct batteries to generate electricity. Learners must follow health and safety guidelines when planning and carrying out practical activities.

To achieve learning outcome 1, learners need to design and build a device to weigh objects and draw a scale on the device using some known masses in order to calibrate it. The device should then be used to weigh slightly heavier and lighter items and these measurements can be compared with the initial mass as measured on an accurate set of scales. The task should provide a realistic context that means the device produced can be seen to be useful by the learner.

Learners need to look closely at examples of available mechanical weighing devices and use them to weigh objects. There are many ways to make a simple weighing device using ideas from commercial mechanical devices. The device produced could use elastic or a spring to produce a simple spring balance with a scale on card. A lever on a pivot could be used with a movable counterbalance so that the pivot can be balanced by moving a weight towards or away from the pivot point and a scale marked on the lever. The accuracy of the device can be assessed by comparing the measurement of an unknown mass on the weighing device with the measurement made on an accurate laboratory balance.

For learning outcome 2, learners will investigate the production of electricity from batteries. They could be introduced to the chemistry taking place inside a battery by observing practical demonstrations or computer simulations. They will then safely construct simple batteries, by experimenting with available materials. Learners will need to use the correct scientific names and describe the main components of a battery. They will demonstrate the generation of electricity from their batteries, for example using LEDs or by measuring the voltage produced using a voltmeter or multimeter. Finally, they will consider the harmful effects of batteries on the environment.

It is important that learners are introduced to designing products, as they may not have much prior experience of this. Learners should be encouraged to become confident in their approach to producing designs from which to construct devices. Tutors will play a crucial role in ensuring this.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

Assessment strategies need to reflect the evidence required for the assessment criteria and should use scientific investigative design and construction. Evidence for this unit might best be produced in the form of practically observed and assessed tasks and/or presentations.

The assessment strategies used should address the need for learners to design and construct the devices, test them and make conclusions. They should also cover the importance of the underlying scientific principles, health and safety and risk analysis during practical investigations.

Suggested resources

Websites

Energy quest science projects: Lemon power	www.energyquest.ca.gov/projects/lemon.html
How stuff works	www.science.howstuffworks.com
Science Enhancement Programme	www.sep.org.uk/
Technology Enhancement Programme	www.tep.org.uk

Unit 14: Using Mathematical Tools in Science

Unit reference number: M/502/5009

QCF level: 2

Credit value: 5

Guided learning hours: 30

Unit aim

This unit enables learners to use mathematical tools which are essential for working in a science environment. Starting with basic numbers and simple algebraic manipulation, learners then move onto collecting and interpreting data on graphs and charts.

Unit introduction

Anyone who works in a science-related area needs to be confident in handling numbers in their day-to-day work. Their calculations may be used to design equipment or to predict how a new chemical is going to work. During experiments, data needs to be accurately collected and results displayed. Valid interpretation of the data is vital in order to make sense of what is going on in science experiments. Without the use of maths, science work would be paralysed.

This unit addresses the need for science workers to learn basic mathematical tools that are essential in the science industry. The intention is not maths *for* maths but maths *for* science and so there is an emphasis on integrating the maths to practical scientific work. By studying this unit learners will have the opportunity to consider a number of important concepts, including:

- how to use the International System of Units (SI) correctly
- how to leave an answer to the correct decimal place or significant figure
- how to manipulate and use simple algebra correctly
- how to measure and calculate experimental errors in experiments
- how to display and interpret experimental data.

In the first learning outcome, the learner is introduced to the basics of maths; leaving answers to the correct decimal or significant figure is emphasised, including correct handling of scientific calculators. This outcome also focuses on how simple algebra helps solve scientific problems. Learning outcome 2 looks at the types of scientific data (primary and secondary) and how scientific data is collected and the errors that may occur during the collection process. The unit concludes by investigating how data can be displayed and how to correctly interpret graphs and charts. Throughout this unit learners will have plenty of opportunities to use graphical scientific calculators and ICT in the various activities available. This unit is vital for anyone intending to follow a scientific pathway.

Essential resources

Using mathematical tools is an essential part of any science technician's work. To deliver this unit the centre will need to provide laboratory space equipped for Level 2 work. Learners will need the facilities to carry out practical work so the technical expertise required at this level can be practised and demonstrated. This will include carrying out practical experiments that allow for the application of the mathematical skills covered in the unit.

Access to scientific calculators, computers, CD ROMs and the internet is also essential. The computers need to have packages for plotting graphs etc. Access to mathematical tutorial packages would be an advantage.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Be able to use mathematical tools in science	1.1	carry out mathematical calculations using suitable mathematical tools	□ *Mathematical tools*: SI units (length, mass, time, area, volume, density, force); conversions eg imperial to metric and vice versa; prefixes eg giga, mega, kilo, deci, centi, milli, micro, nano, pico; accuracy of data (decimal places and significant figures); fractions; percentages; ratios; standard form; use of scientific calculators □ *Scientific problems involving algebra*: transposition of formulae; substitution of equations; simple linear equations eg involving force and mass ($F = ma$), speed and distance ($v = s/t$), mole calculations ($n = m/M_r$), voltage and current ($V = IR$), density and volume ($\rho = m/V$) □ *Mensuration*: standard formulae to solve surface areas eg total surface area of a cylinder = $2\pi rh + 2\pi r^2$, surface area of a sphere = $4\pi r^2$; volume of regular solids eg volume of a cylinder = $\pi r^2 h$, volume of a sphere = $4/3\pi r^3$, volume of a cone = $1/3\pi r^2 h$
		1.2	carry out mathematical calculations using algebra	
2	Be able to collect and record scientific data	2.1	collect and record scientific data	□ *Data collection*: methods eg computer automation, manual collection (eg handling of instruments); primary data eg data obtained from own experiment; secondary data eg data taken from research papers, data taken from website □ *Recording data*: data tables in a lab book eg collecting data manually (borders and correct labelling and units of physical quantities); by data loggers eg when taking data from an experiment over days
		2.2	identify errors associated with collecting data in an experiment	□ *Errors and accuracy*: precision of instrument eg rule, measuring cylinder, micrometer, balance; systematic and random errors; maximum error of instrument eg half the precision value; absolute error of measurement; maximum percentage error of measurement eg maximum error of instrument divided by measurement

Learning outcomes		Assessment criteria		Unit amplification
3	Be able to display and interpret scientific data	3.1	select the appropriate formats to display the scientific data that has been collected	□ *Charts*: data represented by statistical diagrams (bar charts, pie charts); histograms (continuous and discrete variants) □ *Type of graphs*: linear graphs eg distance/time graphs, graphs obeying Ohm's law (voltage against current); non-linear graphs eg rate of catalytic reaction against temperature, hydrogen gas given off against time, radioactive decay, bacterial growth
		3.2	interpret scientific data	□ *Interpretation of data*: random data, patterns in data; calculation of the arithmetic mean, mode and median; continuous data eg rate of production over time, population count of invertebrates or plants; discrete data eg fingerprint type, shoe size; raw and derived data eg measure time and distance travelled by a car and calculate (derive) the speed □ *Interpretation of graph*s: calculating the gradient of a straight line graph; calculating the area under a straight line graph; taking tangents of non-linear graphs in order to determine the gradient at a point; explaining trends in both linear and non-linear graphs

Information for tutors

Delivery

This maths unit should be delivered in the context of solving science problems. It is expected that learners will carry out a number of experiments as part of this unit. There are a number of free internet sites that offer maths help to learners at this level, use of these resources is recommended. The examples indicated in the content gives the tutor ideas of what could be discussed and are not limited to those mentioned. However, it is expected that at least one of the examples will be covered during lessons.

As this is a maths unit it is not appropriate to use the 'triangle' method to solve equations. The 'triangle' method is commonly used to help learners solve science problems (for example Ohm's law) without actually performing the required algebraic manipulation and this unit requires learners to show the relevant competence.

Learning outcome 1 should be taught first and forms the foundation of the whole unit. The first learning outcome requires learners to understand the basics of numbers, including correct conversions between metric and imperial, which are still used in the science workplace. Standard form and correct use of scientific calculators must be covered here. Astronomical distance and microscopic distance provide useful applications of large and small numbers. Fractions and ratio applications could use biological investigations, efficiency calculations in electrical power and determining formulae from percentage composition.

This learning outcome also looks at algebra, which is the basis of all branches of science. Following sound drilling of the rules, learners should be exposed to using algebra in various branches of science. This can be achieved in many ways, for example by using equations of motion, gas laws, molar calculations and their associated laboratory experiment. With the understanding of the basic rules of algebra, mensuration can then be introduced. There are many applications of mensuration in physics and chemistry to bring this section to life. For example, a vein could be modelled as a tube or a water droplet as a sphere.

Learning outcome 2 relates to collecting scientific data. Learners should understand that there are primary and secondary data which are used in different ways and for different reasons. For secondary data, learners could obtain data from the internet for a number of issues such as investigating the effects of smoking, data on global warming, or energy consumption, for example. Scientific primary data could be collected in the maths lessons or through other units. It is important that learners understand what could limit their data collection and the errors that could be associated with the data collection method. Learners need to be convinced of the need for a logbook and a well-defined table, containing correct units and names of the physical quantities being considered.

Learning outcome 3 looks at how data is displayed. All formats should be investigated. Learners could try plotting data on all formats and then comparing their suitability. Learners should be encouraged to plot either the line of best fit or curve of best fit, depending on the data. In addition to plotting by hand, learners should be encouraged to use spreadsheets with plotting functions and various fit capability. There are plenty of opportunities here to integrate experiments, performed in other units, to this section if required.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

For learning outcome 1, learners need to demonstrate that they can convert imperial to metric units and vice versa. Learners should be able to leave calculations to appropriate significant figures and to use a scientific calculator. In all cases, the calculations should be contextualised, to some extent, to the real world and in particular to science. Learners are expected to solve simple problems using algebra. Learners should be exposed to a full range of simple equations within lessons.

The data referred to in assessment criteria 2.1 and 3.1 must be both primary and secondary data. For 2.1, learners need to collect scientific data through an experiment (primary data) and secondary means (secondary data). The data collected could be from any subject in science but it needs to be collected by the learner, although a little assistance can be given for the experimental collection. There should be a brief statement by the learner stating how the data was collected, as well as a table of results of the data. The table should have borders and contain the quantities with the correct units. There must be a reference to the collection method used by the learner whilst obtaining 2.1.

For 2.2, learners are required to identify any errors associated with collecting scientific data in an experiment (ideally the experiment used for 2.1). This could be in the form of a list or a statement. It should include any random and/or systematic errors. It would be acceptable for a learner to mention how they minimised the errors encountered in 2.1.

For 3.1, learners need to select an appropriate format of displaying data. It is expected that learners will be exposed to a full range of formats of displaying data. However, the learner needs only select the appropriate formats for a primary and a secondary set of data. For scatter graphs, the plots need to be accurately plotted on graph paper. In all cases, there should be correct labelling of axes and an appropriate title. For 3.2, learners need to interpret the scientific data they have obtained.

Suggested resources

Books

Johnson T and Clough T – *Aim High 2: Aiming for Grade A/A* in Edexcel GCSE Mathematics* (Edexcel, 2007) ISBN 9781846901881

Metcalf P – *GCSE Edexcel Maths (Revision Guide)* (Collins, 2006) ISBN 9780007213610

Parsons R – *GCSE Maths Edexcel Modular Revision Guide: Higher* (Coordination Group Publications, 2006) ISBN 9781841460932

Pledger K (editor) – *Edexcel GCSE Maths: Higher Student Book* (Heinemann Educational Secondary Division, 2006) ISBN 9781841465463

Journals

iSquared magazine

Mathematical Association

Mathematical Gazette

Mathematics in Schools

Websites

BBC GCSE Bitesize	www.bbc.co.uk/schools/gcsebitesize
BBC Skillswise	www.bbc.co.uk/skillswise
GCSE guide	www.gcseguide.co.uk
Mathstutor	www.mathstutor.com
University of Birmingham selection of mathematics education sites	www.education.bham.ac.uk/

Unit 15: Science in the World

Unit reference number: J/502/5016

QCF level: 2

Credit value: 5

Guided learning hours: 30

Unit aim

The unit will enable learners to consider the various influences on scientific developments and advances and how they in turn impact the world around us.

Unit introduction

This unit allows learners to explore the role science has in a wider context. The learner will look at how much science influences their world and also what pressures are put on the science community. Learners will use their knowledge of science to explore these pressures on the scientific community and equally to look at how science can influence people in general.

In this unit learners will investigate how the media and society interact with the scientific community. These interactions are often of great benefit to society but at other times they may be less than positive. It is intended that learners will be able to pick some scientific topics and put forward well-reasoned arguments to help everybody understand them. Learners should also look at the applications of science including some 'blue sky' ideas.

Scientists have never worked in a vacuum: there have always been pressures on scientists from a variety of sources such as religion, politics, public opinion and the law. In some respects the advent of speedier and more accessible communications has been both a benefit and a hindrance to science. Discoveries are published in specialist journals but quickly picked up by the popular press with headlines about 'miracle cures' etc. Equally, scientists publish their results hoping to catch the imagination of the press and therefore claim the glory for a discovery or advance in science. This often leads to false expectations and the blaming of science for not being honest with the public. This unit starts the process of exploring how science and society are interdependent and the great benefits that scientific progress has given society in general.

When learners finish this unit they should be able to show an understanding of some current scientific topics and how they are seen in the wider community. Learners should be able to express their own opinions supported by facts and good reasoning techniques. In this way when they tackle other units they should have the skills to give a logical and well-reasoned argument backed by facts.

Essential resources

Access to library and internet data is essential, but laboratory space is not required. Relevant journals, daily papers, weeklies and periodicals either in hard copy or on the internet are essential. Access to television channels via cable and satellite would be useful, especially for 24-hour news and other topical programmes including any specialising in science topics.

Colleagues from within the teaching centre and/or outside speakers with a knowledge of the media, sociology, politics, law, economics, morals and ethics are valuable contributors to this unit. The use of tutors from these backgrounds would help the science assessor to get a full picture of the work presented by learners. Depending on what kind of presentation the learner wants to use, access to recording equipment might be needed.

Learning outcomes, assessment criteria and unit amplification

To pass this unit, the learner needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes		Assessment criteria		Unit amplification
1	Understand some of the factors that can influence scientific progress	1.1	discuss how external factors can influence scientific progress	□ *Influences*: public concern; financial matters; economic pressures; animal/civil rights groups; scientific opinion; overseas pressures; funding for research □ *Effect of influences*: speed of development; cost of testing and making products; increased demand; cost/availability of raw materials; expectations of what can be achieved; public awareness; need for return of investment in research and development (R&D) by companies
2	Understand how science can be represented in the media	2.1	discuss a recent controversial scientific topic that was in the media spotlight	□ *Media*: forms of media eg radio, television, newspapers, magazines, internet, films, blogs □ *Media representation of topics*: various outputs eg in documentaries, plays, soaps, serials, docudramas, news bulletins, 24-hour news programmes, specialist versus general reporting
3	Know how some scientific discoveries have been used in society	3.1	describe the advantages and disadvantages of how some scientific discoveries are used in society	□ *Discoveries/advances and their uses*: nanoparticles eg cosmetics, sports clothes; materials used in space eg non-stick substances, heat-resistant tiles on space rockets; development of alternative sources of energy eg water and wind turbines, nuclear power, eco-fuels; communication systems eg satellites for global positioning systems (GPS), radio/TV international links; development of materials eg stainless steel, petroleum by-products, prosthetics; pharmaceutics eg vaccinations, disease-controlling chemicals; development of medical apparatus eg magnetic resonance images (MRI) scans, radiography, laser instruments in surgery; computer-controlled developments

Learning outcomes		Assessment criteria		Unit amplification
				□ *Advantages*: medical advances which save lives eg development of precision drugs to target cancer cells; new technology gives faster/better communications; new materials have better properties than others eg heat/cold resistant, non-flammable, longer lasting, flexible in their uses; computer-controlled devices eg robots to work in situations unsuitable for humans and to carry out repetitive actions in manufacturing □ *Disadvantages*: effects on environment eg effect of nanoparticle technology on water supplies, air quality, contamination of food chains; use of limited natural resources; long-term effects eg waste from nuclear power, effect of wind turbines on bird migration routes, mobile phone transmitters and radiation; costs eg of developing new technology; misuse of new technology eg biological and chemical warfare, spy satellites, surveillance cameras
4	Know some of the consequences associated with scientific discoveries/ advances	4.1	describe some consequences associated with recent scientific discoveries/advances	□ *Scientific discoveries/advances*: recent discoveries/advances eg cloning of animals, genetic manipulation of plants (GM crops), testing kits for self diagnosis, miniaturisation of components eg cameras, listening and tracking devices; development of new memory materials, intelligent drugs eg stimuli-responsive polymers, pills with radio receiver/transmitter to deliver drugs in correct dosage at the correct site in the body □ *Problems*: cloning of animals eg unwanted animals, in-breeding of animals and its consequences, lack of variety, small genetic gene pool; self diagnosis kits eg accuracy of results, no medical follow-up, validity of kits; miniaturisation of components eg use of devices for legal/illegal purposes, cost of use in medical diagnosis/treatment of newly developed techniques and drugs

Learning outcomes		Assessment criteria		Unit amplification
				□ *Solutions to problems*: controls eg laws passed by parliament, industry self-regulation, legal opposition; civil rights activists; public awareness; regulation of costs of new drugs/technology; limiting availability of discoveries/advances in science □ *Impact*: the immediate and delayed effects on quality of life and standard of living; intended; unintended; fortune; misfortune; environmental effects; health; longevity; progress

Information for tutors

Delivery

This unit enables learners to apply their science knowledge. They will be looking at science in the world so the tutor will need to provide factual and stimulus material and use case studies to prepare the learners for discussion groups. At the end of the unit learners should be able to consider science objectively and develop a balanced view of its place in the world.

Specialist speakers provide the background to this unit, especially those with experience and interest in the media, philosophy and politics. After the factual input and discussions with the tutors and guest speakers, the learners will use their main tutor as a facilitator/mentor. The idea is that learners create an action plan with their tutor detailing how they will meet the learning outcomes and assessment criteria. The action plan is a 'live' document and should be reviewed constantly by the learner and the tutor to make sure the goals and target dates set are being met. This is essential to prevent loss of momentum and ensure the focus is kept on the material to be covered.

Learning outcome 1 enables learners to look at the factors that influence scientific progress. The tutor will probably need to initiate discussions and the use of tutors with non-science backgrounds is useful in helping the learners to look at the wider picture. Learners should be made aware of the influences/pressures from within the science world as well as those involving economics, morals, ethics or politics. Tutors should encourage learners to present a balanced view of the influences they study as pressure has often been the stimulus to great discoveries.

Learning outcome 2 covers science and the media. Allow learners to look at all kinds of media which the public might come across and what kind of audience they target. Access to all forms of the media are needed, including journals, newspapers and other sources of information which learners may not know about or use. They will probably be familiar with television and online material found on a variety of internet sites but their knowledge of the media should be wider than this. In this learning outcome learners need to look at the science being covered in the media and the way science is reported. Following on from this they should look at the influence of the media, not forgetting the bias in some publications and the target audiences. Again, the learners' discussions can include their opinions but they must be backed up by facts and reasoned arguments.

Learning outcome 3 investigates the uses that scientific discoveries or advances may be put to. Learners can investigate any scientific or technological advances and discoveries which are of interest to them. They can choose them from any era but it would make sense to choose at least one very recent discovery. The usefulness of the discovery does not have to be purely for the benefit of people, ie saving lives. The use of advanced animation techniques, along with the development of computer programs and microchip technology has given long hours of entertainment to many people. It is not useful in the usual sense of the word but one side effect has been the development of good hand/eye co-ordination in children using some computer games, and it is an example that many can relate to. This outcome provides the opportunity for discussion and research involving the tutor and interested colleagues.

Learning outcome 4 is an opportunity for learners to explore some scientific discoveries/advances through discussion with the tutor and via their own research. Arising from this work learners need to consider the consequences of some of the advances or discoveries made.

Allow learners to question the validity, usefulness and the ethics of any aspects of the discoveries/advances they find out. Learners should become aware of conflicting opinions often being equally valid without losing sight of scientific facts and knowledge. Encourage learners to explain the consequences of the discoveries explored without being too judgemental.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

The tutor should try to be as flexible as possible so the learner can use a variety of means to present their work without losing sight of the need for all the criteria to be met. Whatever method is chosen for presentation by the learner, the tutor must make sure formative assessment is done throughout the assignment process.

For assessment criteria 1.1 and 2.1 the learner is going to show they can carry out research and find some recent scientific discoveries or advances. They should be encouraged to choose them from different sciences and technologies. Learners need to show the tutor that they have used reputable sources which can be checked. Besides being able to discuss the advances chosen, learners have to look at what factors have influenced the progress of the scientific discoveries they have researched. Did it help people to be healthier or live better lives? Did the discovery help in animal welfare and farming? Did it enable bigger and better crops to be grown or help farmers grow crops under difficult circumstances? Did any of the factors influence the progress being made in this area of research? Encourage learners to look at technology developments as well. Enable learners to think widely about what influences there might be, for example funding for research, who controls the funding, profits to be made from discoveries, the effect of the media, public opinion. The input from other tutors is very valuable here in helping learners think broadly and from different points of view, for example political, philosophical.

The choice of a controversial scientific topic for 2.1 may require some tutor guidance, but let the learner have as much freedom to choose as possible.

For 3.1 and 4.1 the advances/discoveries from 1.1 and 2.1 can be used or different ones chosen. Again, guidance from the tutor about choice of topics is needed but allow as much freedom of choice as possible. Assessment criterion 4.1 concentrates on the consequences of discoveries and advances in science and learners need to describe them rather than just making a list.

Learners will require significant assistance from the tutor, particularly in the design of the devices. To carry out the investigative work, learners will require a brief which will guide them through the practical work. Learners must be able to safely follow simple scientific procedures and be able to use relevant scientific terminology.

Suggested resources

Books

Curran J – *Mass Media and Society* (Hodder Arnold, 2005) ISBN 9780340884997

O'Sullivan T et al – *Studying the Media* (Hodder Arnold,2003) ISBN 9780340807651

Perry J and Challoner J – *Giant Leaps: Mankind's Greatest Scientific Advances* (Boxtree Ltd, 2006) ISBN 9780752226248

Journals

New Scientist

Websites

Advancing Science, Serving Society – Project 2061	www.project2061.org
The Association of Science education	www.ase.org.uk/
Materials Today	www.materialstoday.com
Science, nature, technology	www.kosmoi.com/

13 Further information and useful publications

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- Work-based learning: **www.pearsonwbl.com/contactus**
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- Edexcel Equality Policy
- Edexcel Information Manual (updated annually)
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14 Professional development and training

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Publications Code FL033244 September 2012

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