City & Guilds Level 3 Certificate, Subsidiary Diploma, 90-Credit Diploma, Diploma, Extended Diploma in Agriculture (0073-03)

www.cityandguilds.com
April 2022
Version 2.1

Qualification handbook for centres
500/8488/4
500/8388/0
600/6048/7
500/8487/2
500/8490/2

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As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. We offer over 500 qualifications across 28 industries through 8500 centres worldwide and award around two million certificates every year. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

City & Guilds Group

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Qualification title	Number	QAN
City & Guilds Level 3 Certificate in Agriculture	0073-03	500/8488/4
City & Guilds Level 3 Subsidiary Diploma in Agriculture	0073-03	500/8388/0
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City & Guilds Level 3 Diploma in Agriculture	0073-03	500/8487/2
City & Guilds Level 3 Extended Diploma in Agriculture	0073-03	500/8490/2

Version and date	Change detail	Section
Version 1 to 2	First edition updated to correct minor errors	Throughout
2.1 April 2022	TQT and GLH clarified and highlighted	Introduction to the qualifications

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Contents

1 Introduction to the qualifications

This document contains the information that centres need to offer the following qualifications:

Qualification title and level	City & Guilds qualification number	Qualification accreditation number
City & Guilds Level 3 Certificate in Agriculture	0073-03	500/8488/4
City & Guilds Level 3 Subsidiary Diploma in Agriculture	0073-03	500/8388/0
City & Guilds Level 3 90-Credit Diploma in Agriculture	0073-03	600/6048/7
City & Guilds Level 3 Diploma in Agriculture	0073-03	500/8487/2
City & Guilds Level 3 Extended Diploma in Agriculture	0073-03	500/8490/2

Qualification summary

Qualification title and level	Credits	Guided Learning Hours (GLH)	Total Qualification Time (TQT)
City & Guilds Level 3 Certificate in Agriculture	30	180	300
City & Guilds Level 3 Subsidiary Diploma in Agriculture	60	360	600
City & Guilds Level 3 90-Credit Diploma in Agriculture	90	540	900
City & Guilds Level 3 Diploma in Agriculture	120	720	1000
City & Guilds Level 3 Extended Diploma in Agriculture	180	1080	1800

These qualifications meet the needs of learners in a centre-based environment who may wish to work within the agricultural industry or progress to further learning and/or training. These qualifications allow learners to develop underpinning knowledge whilst practising skills that could be used within employment in the agriculture industry. These qualifications replace the Level 3 Advanced National Certificate in Agriculture (0340-03) which expired on 31 December 2010 (QAN 100/1695/8).

These qualifications were developed in association with Lantra SSC, Landex and the industry.

Specialist Learning (SL)

Specialist Learning (SL) offers young people the opportunity to study a particular topic in more depth or broaden their studies through complementary learning. The Level 3 Certificate and Subsidiary Diploma in Agriculture have been approved as SL by the Environmental and Land-based Diploma DDP and Ofqual for the Advanced Diploma in Environmental and Land-based Studies. They have been designed to:

- complement principal learning within the Advanced Diploma in Environmental and Land-based Studies
- provide a broad background understanding of the Environmental and Land-based sector and an introduction to the practical skills and knowledge required
- provide an awareness of the range of jobs and work settings in the agricultural sector
- enable learners to make an informed assessment of their own aptitude for work in this sector and to make informed decisions about careers
- encourage learners to reach a level of knowledge and skills that will facilitate progress into further vocational learning or to potential employment in the sector
- introduce learners to the discipline of the working environment and to encourage mature

attitudes to the community in general
- encourage learners to value continued learning and remain in the learning process
- allow learners to learn, develop and practise selected skills required for progression in the sector
- provide opportunities for progression to the Advanced Diploma in Environmental and Land-based and other related qualifications in the sector.

1.1 Qualification structure

City & Guilds Level 3 Certificate

To achieve the **City & Guilds Level 3 Certificate in Agriculture,** learners are required to achieve 30 credits from any combination of Optional group units in the table below.

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
Optional group			
L6009149	Unit 302	Understand the Principles of Plant Science	5
T6009579	Unit 303	Understand the Principles of Soil Science	5
M6009127	Unit 307	Undertake Agricultural Crop Production	10
A6009129	Unit 308	Undertake Agricultural Livestock Production	10
L6009135	Unit 309	Understand Farm Power Units - Machinery and Operation	10
Y6009610	Unit 310	Undertake Estate Skills	10
H6009643	Unit 311	Understanding Principles of Land-based Machinery	10
D6009365	Unit 314	Understand and Promote Animal Health	10
R6009136	Unit 315	Understand Grassland Management	10
D6009141	Unit 316	Understanding Livestock Breeding and Nutrition	10
H6009805	Unit 320	Undertaking Land-based Machinery Operations	10

M6009631	Unit 321	Undertaking Land-based Workshop Practice	10
J6009635	Unit 322	Undertaking Specialised Land-based Workshop Practices	10
K6009580	Unit 324	Undertake Dairy Production	10
M6009581	Unit 325	Undertake Beef Production	10
F6009147	Unit 326	Undertaking Pig Production	10
J6009148	Unit 327	Undertaking Poultry Production	10
F6009150	Unit 328	Undertaking Sheep Production	10
A6009132	Unit 332	Understand and Use Agricultural Spreaders and Sprayers	10
L6009457	Unit 338	Understand and Carry Out Farm Livestock Husbandry	10
R5034916	Unit 339	Undertaking Agricultural Combinable Crop Production	10

City & Guilds Level 3 Subsidiary Diploma

To achieve the **City & Guilds Level 3 Subsidiary Diploma in Agriculture,** learners are required to achieve 10 credits in the Mandatory group (learners need to achieve either Animal Anatomy and Physiology **OR** Principles of Plant Science **and** Principles of Soil Science). A further 50 credits are required from the Optional group units in the table below. A total of 60 credits are required to achieve this qualification.

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
Mandatory group			
K6009367	Unit 301	Understand Animal Anatomy and Physiology	10
OR			
L6009149	Unit 302	Understand the Principles of Plant Science	5
T6009579	Unit 303	Understand the Principles of Soil Science	5
Optional group			
K6009367	Unit 301	Understand Animal Anatomy and Physiology	10
L6009149	Unit 302	Understand the Principles of Plant Science	5
T6009579	Unit 303	Understand the Principles of Soil Science	5
M6010021	Unit 304	Undertake an Investigative Project in the Land-based Sector	10
M6009709	Unit 306	Business Management in the Land-based Sector	10
M6009127	Unit 307	Undertake Agricultural Crop Production	10
A6009129	Unit 308	Undertake Agricultural Livestock Production	10

L6009135	Unit 309	Understand Farm Power Units - Machinery and Operation	10
Y6009610	Unit 310	Undertake Estate Skills	10
H6009643	Unit 311	Understanding Principles of Land-based Machinery	10
T6009128	Unit 312	Understand Agricultural Forage Crop Production	10
M6009130	Unit 313	Understand Agricultural Organic Production	10
D6009365	Unit 314	Understand and Promote Animal Health	10
R6009136	Unit 315	Understand Grassland Management	10
D6009141	Unit 316	Understanding Livestock Breeding and Nutrition	10
T6009582	Unit 317	Undertaking Root Crop and Field Vegetable Production	10
L6009801	Unit 318	Undertake Land-based Industries Pollution and Waste Control Management	10
F6009620	Unit 319	Undertaking Farm Habitat Management	10
H6009805	Unit 320	Undertaking Land-based Machinery Operations	10
M6009631	Unit 321	Undertaking Land-based Workshop Practice	10
J6009635	Unit 322	Undertaking Specialised Land-based Workshop Practices	10

F6009133	Unit 323	Manage Agricultural Environments	10
K/600/9580	Unit 324	Undertake Dairy Production	10
M6009581	Unit 325	Undertake Beef Production	10
F6009147	Unit 326	Undertaking Pig Production	10
J6009148	Unit 327	Undertaking Poultry Production	10
F6009150	Unit 328	Undertaking Sheep Production	10
T6009145	Unit 329	Mechanised Agricultural Crop Handling and Storage	10
J6009389	Unit 330	Understand the Principles of Animal Biology	10
F6009701	Unit 331	Participate in Business Planning and Improvement in the Land-based Sector	10
A6009132	Unit 332	Understand and Use Agricultural Spreaders and Sprayers	10
R5025536	Unit 333	Fundamentals of Science	10
D6009463	Unit 334	Understand the Principles of Inheritance and Genetic Manipulation	10
K5025557	Unit 335	Chemistry for Biology Technicians	10
J6009439	Unit 336	Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology	10

A6009714	Unit 337	Understand the Principles of Chemistry for Biological and Medical Science	10
L6009457	Unit 338	Understand and Carry Out Farm Livestock Husbandry	10
R5034916	Unit 339	Undertaking Agricultural Combinable Crop Production	10

City & Guilds Level 3 90-Credit Diploma

To achieve the **City & Guilds Level 3 90-Credit Diploma in Agriculture**, learners are required to achieve 10 credits in the Mandatory group (learners need to achieve either Animal Anatomy and Physiology **OR** Principles of Plant Science **and** Principles of Soil Science). A further 80 credits are required from the Optional group units in the table below. A total of 90 credits are required to achieve this qualification.

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
Mandatory group			
K6009367	Unit 301	Understand Animal Anatomy and Physiology	10
OR			
L6009149	Unit 302	Understand the Principles of Plant Science	5
T6009579	Unit 303	Understand the Principles of Soil Science	5
Optional group			
K6009367	Unit 301	Understand Animal Anatomy and Physiology	10
L6009149	Unit 302	Understand the Principles of Plant Science	5
T6009579	Unit 303	Understand the Principles of Soil Science	5
M6010021	Unit 304	Undertake an Investigative Project in the Land-based Sector	10
R6009394	Unit 305	Undertake and Review Work Related Experience in the Land-based Industries	10
M6009709	Unit 306	Business Management in the Land-based Sector	10
M6009127	Unit 307	Undertake Agricultural Crop Production	10

A6009129	Unit 308	Undertake Agricultural Livestock Production	10
L6009135	Unit 309	Understand Farm Power Units - Machinery and Operation	10
Y6009610	Unit 310	Undertake Estate Skills	10
H6009643	Unit 311	Understanding Principles of Land-based Machinery	10
T6009128	Unit 312	Understand Agricultural Forage Crop Production	10
M6009130	Unit 313	Understand Agricultural Organic Production	10
D6009365	Unit 314	Understand and Promote Animal Health	10
R6009136	Unit 315	Understand Grassland Management	10
D6009141	Unit 316	Understanding Livestock Breeding and Nutrition	10
T6009582	Unit 317	Undertaking Root Crop and Field Vegetable Production	10
L6009801	Unit 318	Undertake Land-based Industries Pollution and Waste Control Management	10
F6009620	Unit 319	Undertaking Farm Habitat Management	10
H6009805	Unit 320	Undertaking Land-based Machinery Operations	10
M6009631	Unit 321	Undertaking Land-based Workshop Practice	10

J6009635	Unit 322	Undertaking Specialised Land-based Workshop Practices	10
F6009133	Unit 323	Manage Agricultural Environments	10
K/600/9580	Unit 324	Undertake Dairy Production	10
M6009581	Unit 325	Undertake Beef Production	10
F6009147	Unit 326	Undertaking Pig Production	10
J6009148	Unit 327	Undertaking Poultry Production	10
F6009150	Unit 328	Undertaking Sheep Production	10
T6009145	Unit 329	Mechanised Agricultural Crop Handling and Storage	10
J6009389	Unit 330	Understand the Principles of Animal Biology	10
F6009701	Unit 331	Participate in Business Planning and Improvement in the Land-based Sector	10
A6009132	Unit 332	Understand and Use Agricultural Spreaders and Sprayers	10
R5025536	Unit 333	Fundamentals of Science	10
D6009463	Unit 334	Understand the Principles of Inheritance and Genetic Manipulation	10
K5025557	Unit 335	Chemistry for Biology Technicians	10

J6009439	Unit 336	Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology	10
A6009714	Unit 337	Understand the Principles of Chemistry for Biological and Medical Science	10
L6009457	Unit 338	Understand and Carry Out Farm Livestock Husbandry	10
R5034916	Unit 339	Undertaking Agricultural Combinable Crop Production	10

City & Guilds Level 3 Diploma

To achieve the **City & Guilds Level 3 Diploma in Agriculture**, learners are required to achieve 20 credits from the Mandatory group 1 plus 10 credits from Mandatory Group 2 (learners need to achieve **either** Unit 301 Animal Anatomy and Physiology **OR** both the following units Unit 302 Principles of Plant Science and Unit 303 Principles of Soil Science). A further 90 credits are required from the Optional units in the table below. A total of 120 credits are required to achieve this qualification.

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
Mandatory group 1			
M6010021	Unit 304	Undertake an Investigative Project in the Land-based Sector	10
R6009394	Unit 305	Undertake and Review Work Related Experience in the Land-based Industries	10
Mandatory group 2			
K6009367	Unit 301	Understand Animal Anatomy and Physiology	10
OR			
L6009149	Unit 302	Understand the Principles of Plant Science	5
T6009579	Unit 303	Understand the Principles of Soil Science	5
Optional Units			
K6009367	Unit 301	Understand Animal Anatomy and Physiology	10
L6009149	Unit 302	Understand the Principles of Plant Science	5
T6009579	Unit 303	Understand the Principles of Soil Science	5
M6009709	Unit 306	Business Management in the Land-based Sector	10
M6009127	Unit 307	Undertake Agricultural Crop Production	10

A6009129	Unit 308	Undertake Agricultural Livestock Production	10
L6009135	Unit 309	Understand Farm Power Units - Machinery and Operation	10
Y6009610	Unit 310	Undertake Estate Skills	10
H6009643	Unit 311	Understanding Principles of Land-based Machinery	10
T6009128	Unit 312	Understand Agricultural Forage Crop Production	10
M6009130	Unit 313	Understand Agricultural Organic Production	10
D6009365	Unit 314	Understand and Promote Animal Health	10
R6009136	Unit 315	Understand Grassland Management	10
D6009141	Unit 316	Understanding Livestock Breeding and Nutrition	10
T6009582	Unit 317	Undertaking Root Crop and Field Vegetable Production	10
L6009801	Unit 318	Undertake Land-based Industries Pollution and Waste Control Management	10
F6009620	Unit 319	Undertaking Farm Habitat Management	10
H6009805	Unit 320	Undertaking Land-based Machinery Operations	10
M6009631	Unit 321	Undertaking Land-based Workshop Practice	10

J6009635	Unit 322	Undertaking Specialised Land-based Workshop Practices	10
F6009133	Unit 323	Manage Agricultural Environments	10
K6009580	Unit 324	Undertake Dairy Production	10
M6009581	Unit 325	Undertake Beef Production	10
F6009147	Unit 326	Undertaking Pig Production	10
J6009148	Unit 327	Undertaking Poultry Production	10
F6009150	Unit 328	Undertaking Sheep Production	10
T6009145	Unit 329	Mechanised Agricultural Crop Handling and Storage	10
J6009389	Unit 330	Understand the Principles of Animal Biology	10
F6009701	Unit 331	Participate in Business Planning and Improvement in the Land-based Sector	10
A6009132	Unit 332	Understand and Use Agricultural Spreaders and Sprayers	10
R5025536	Unit 333	Fundamentals of Science	10
D6009463	Unit 334	Understand the Principles of Inheritance and Genetic Manipulation	10
K5025557	Unit 335	Chemistry for Biology Technicians	10

J6009439	Unit 336	Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology	10
A6009714	Unit 337	Understand the Principles of Chemistry for Biological and Medical Science	10
L6009457	Unit 338	Understand and Carry Out Farm Livestock Husbandry	10
R5034916	Unit 339	Undertaking Agricultural Combinable Crop Production	10
H6003437	Unit 340	Land Based Engineering Operations – Service and Repair Engines and Components	10
K6014262	Unit 341	Understanding and Servicing Land-based Machinery (Cultivation and Planting Machinery)	10
K6014259	Unit 342	Understanding and Servicing Land-based Harvesting Machinery (Cutting and Lifting)	10
M6014263	Unit 343	Understanding and Servicing Mechanical Power Transmission Systems	10

City & Guilds Level 3 Extended Diploma

To achieve the **City & Guilds Level 3 Extended Diploma in Agriculture**, learners are required to achieve 30 credits from Mandatory group 1 in the table below plus 10 credits from Mandatory group 2 (learners need to achieve **either** Unit 301 Animal Anatomy and Physiology **OR** Unit 302 Principles of Plant Science **AND** Unit 303 Principles of Soil Science). A further 140 credits are required from the Optional units in the table below. A total of 180 credits is required to achieve the qualification.

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
Mandatory group 1			
M6010021	Unit 304	Undertake an Investigative Project in the Land-based Sector	10
R6009394	Unit 305	Undertake and Review Work Related Experience in the Land-based Industries	10
M6009709	Unit 306	Business Management in the Land-based Sector	10
Mandatory group 2			
K6009367	Unit 301	Understand Animal Anatomy and Physiology	10
OR			
L6009149	Unit 302	Understand the Principles of Plant Science	5
T6009579	Unit 303	Understand the Principles of Soil Science	5
Optional Units			
K6009367	Unit 301	Understand Animal Anatomy and Physiology	10
L6009149	Unit 302	Understand the Principles of Plant Science	5
T6009579	Unit 303	Understand the Principles of Soil Science	5
M6009127	Unit 307	Undertake Agricultural Crop Production	10

A6009129	Unit 308	Undertake Agricultural Livestock Production	10
L6009135	Unit 309	Understand Farm Power Units - Machinery and Operation	10
Y6009610	Unit 310	Undertake Estate Skills	10
H6009643	Unit 311	Understanding Principles of Land-based Machinery	10
T6009128	Unit 312	Understand Agricultural Forage Crop Production	10
M6009130	Unit 313	Understand Agricultural Organic Production	10
D6009365	Unit 314	Understand and Promote Animal Health	10
R6009136	Unit 315	Understand Grassland Management	10
D6009141	Unit 316	Understanding Livestock Breeding and Nutrition	10
T6009582	Unit 317	Undertaking Root Crop and Field Vegetable Production	10
L6009801	Unit 318	Undertake Land-based Industries Pollution and Waste Control Management	10
F6009620	Unit 319	Undertaking Farm Habitat Management	10
H6009805	Unit 320	Undertaking Land-based Machinery Operations	10
M6009631	Unit 321	Undertaking Land-based Workshop Practice	10

J6009635	Unit 322	Undertaking Specialised Land-based Workshop Practices	10
F6009133	Unit 323	Manage Agricultural Environments	10
K6009580	Unit 324	Undertake Dairy Production	10
M/600/9581	Unit 325	Undertake Beef Production	10
F6009147	Unit 326	Undertaking Pig Production	10
J6009148	Unit 327	Undertaking Poultry Production	10
F6009150	Unit 328	Undertaking Sheep Production	10
T6009145	Unit 329	Mechanised Agricultural Crop Handling and Storage	10
J6009389	Unit 330	Understand the Principles of Animal Biology	10
F6009701	Unit 331	Participate in Business Planning and Improvement in the Land-based Sector	10
A6009132	Unit 332	Understand and Use Agricultural Spreaders and Sprayers	10
R5025536	Unit 333	Fundamentals of Science	10
D6009463	Unit 334	Understand the Principles of Inheritance and Genetic Manipulation	10
K5025557	Unit 335	Chemistry for Biology Technicians	10

J6009439	Unit 336	Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology	10
A6009714	Unit 337	Understand the Principles of Chemistry for Biological and Medical Science	10
L6009457	Unit 338	Understand and Carry Out Farm Livestock Husbandry	10
R5034916	Unit 339	Undertaking Agricultural Combinable Crop Production	10
H6003437	Unit 340	Land Based Engineering Operations – Service and Repair Engines and Components	10
K6014262	Unit 341	Understanding and Servicing Land-based Machinery (Cultivation and Planting Machinery)	10
K6014259	Unit 342	Understanding and Servicing Land-based Harvesting Machinery (Cutting and Lifting)	10
M6014263	Unit 343	Understanding and Servicing Mechanical Power Transmission Systems	10

1.2 Opportunities for progression

On completion of these qualifications, learners may progress into employment or to the following City & Guilds qualifications:

- Level 4 and above centre-based qualifications in Agriculture e.g. Foundation Degree, Higher National Diploma
- Level 3 or 4 qualifications in Work-based Agriculture
- Other related qualifications

1.3 Qualification support materials

City & Guilds also provides the following publications and resources specifically for these qualifications:

Description	How to access
Assignment guide	www.cityandguilds.com
Marking guide	information@cityandguilds.com
Information Sheets	www.cityandguilds.com
Fast track approval forms/generic fast track approval form	www.cityandguilds.com

2 Centre requirements

This section outlines the approval processes for Centres to offer these qualifications and any resources that Centres will need in place to offer the qualifications including qualification-specific requirements for Centre staff.

Centres already offering the Level 3 Advanced National Certificate in Agriculture (0340-03) (QAN 100/1695/8)

Centres approved to offer the qualification Level 3 Advanced National Certificate in Agriculture (0340-03) (QAN 100/1695/8) may apply for approval for the new Level 3 Certificate, Subsidiary Diploma, Diploma and Extended Diploma in Agriculture using the **fast track approval form**, available from the City & Guilds website.

Centres may apply to offer the new qualifications using the fast track form

- providing there have been no changes to the way the qualifications are delivered, and
- if they meet all of the approval criteria specified in the fast track form guidance notes.

Fast track approval is available for 12 months from the launch of the qualification. After this time, the qualification is subject to the **standard** Qualification Approval Process. It is the centre's responsibility to check that fast track approval is still current at the time of application.

New centres must apply for centre and qualification approval. Further information on this process is available on the City & guilds website.

Existing City & Guilds centres that do not offer Level 3 Advanced National Certificate in Agriculture (0340-03) will need to get specific qualification approval to run these qualifications (contact your City & Guilds Local Office).

2.1 Resource requirements

Human resources

Staff delivering these qualifications must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be technically competent in the areas for which they are delivering training and/or have experience of providing training. This knowledge must be at least to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- be occupationally knowledgeable in the areas of agriculture for which they are delivering training. This knowledge must be at least to the same level as the training being delivered
- have credible experience of providing training.

Centre staff may undertake more than one role, e.g. tutor and assessor or internal verifier, but must never internally verify their own assessments.

Assessors and internal verifiers

The centre must provide Assessor personnel who must be occupationally competent in the industry either qualified to at least level 3 and/or have current experience of working in the industry at this level.

The centre must provide Internal Quality Assurance personnel who must be occupationally competent in the land-based sector either qualified to at least level 3 and/or have current experience of working in the industry at this level.

Assessors/Internal Quality Assurance personnel may hold relevant qualifications such as D32/33/34 or A1/V1 or TAQA however they are not a mandatory requirement for this qualification. They should have had formal training in assessment/IQA, which may be the qualifications above, or other training that allows the assessor to demonstrate competence in the practice of assessment/IQA. This training may be carried out in-house or with an external agency.

TAQA qualifications are considered very appropriate as Continuing Professional Development (CPD) or as best practice standards for new centre staff to work towards.

Continuing professional development (CPD)

Centres are expected to support their staff in ensuring that their knowledge remains current of the occupational area and of best practice in delivery, mentoring, training, assessment and verification, and that it takes account of any national or legislative developments.

2.2 Learner Entry Requirements

There are no formal entry requirements for learners undertaking these qualifications. However, centres must ensure that learners have the potential and opportunity to gain the qualifications successfully.

As part of the assessment for the Level 3 Diploma and Extended Diploma qualifications, learners must have access to a work setting/placement.

2.3 Age restrictions

These qualifications have been approved and accredited for 16-18, 18+ and 19+ learners. However, there are no age limits attached to learners undertaking the qualification unless this is a legal requirement of the process or the environment.

3 Course design and delivery

3.1 Initial assessment and induction

Centres will need to make an initial assessment of each learner prior to the start of their programme to ensure they are entered for an appropriate type and level of qualification.

The initial assessment should identify:

- any specific training needs the learner has, and the support and guidance they may require when working towards their qualifications. This is sometimes referred to as diagnostic testing.
- any units the learner has already completed, or credit they have accumulated which is relevant to the qualifications they are about to begin.

City & Guilds recommends that centres provide an induction programme to ensure the learner fully understands the requirements of the qualifications they will work towards, their responsibilities as a learner, and the responsibilities of the centre. It may be helpful to record the information on a learning contract.

3.2 Recommended delivery strategies

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualifications before designing a course programme.

Centres may design course programmes of study in any way which:

- best meets the needs and capabilities of their learners
- satisfies the requirements of the qualifications.

When designing and delivering the course programme, centres might wish to incorporate other teaching and learning that is not assessed as part of the qualifications. This might include the following:

- Functional skills
- Personal learning and thinking skills (PLTS)

Where applicable, this could involve enabling the learner to access relevant qualifications covering these skills.

4 Assessment

4.1 Summary of assessment methods

For these qualifications, learners will be required to complete the following assessments:

- **one** assignment for **each** unit

City & Guilds provides the following assessments:

- Assignment guide containing assignments for each unit.

Time constraints

The following time constraints must be applied to the assessment of these qualifications:

- All assignments must be completed and assessed within the learner's period of registration. Centres should advise learners of any internal timescales for the completion and marking of individual assignments.

4.2 Assignments

The assignment guide for these qualifications is available to download from www.cityandguilds.com.

4.3 Recognition of prior learning (RPL)

Recognition of Prior Learning (RPL) recognises the contribution a person's previous experience could contribute to a qualification. RPL is allowed and is also sector specific.

4.4 Resubmission of Assignments

Centres are advised to adopt the following policy on the re-submission of work:

Learners who fail an assignment on the formal (summative) submission, or who would like the opportunity to improve their grade, may re-submit once only and may then achieve either a Pass, Merit or Distinction as appropriate. An appropriate time period between formal submission and re-submission should be set by the centre. Multiple re-submissions are not permitted. Learners who fail to hand in work on the formal submission date, where there is no legitimate reason, should be capped to a maximum of a Pass grade only at the re-submission stage. It is at the discretion of the centre to set informal (formative) submission dates, if appropriate, and a formal submission date.

Units

Summary of units

City & Guilds unit number	Title	QCF unit number	Credits
Unit 301	Understand Animal Anatomy and Physiology	K6009367	10
Unit 302	Understand the Principles of Plant Science	L6009149	5
Unit 303	Understand the Principles of Soil Science	T6009579	5
Unit 304	Undertake an Investigative Project in the Land-based Sector	M6010021	10
Unit 305	Undertake and Review Work Related Experience in the Land-based Industries	R6009394	10
Unit 306	Business Management in the Land-based Sector	M6009709	10
Unit 307	Undertake Agricultural Crop Production	M6009127	10
Unit 308	Undertake Agricultural Livestock Production	A6009129	10
Unit 309	Understand Farm Power Units - Machinery and Operation	L6009135	10
Unit 310	Undertake Estate Skills	Y6009610	10
Unit 311	Understanding Principles of Land-based Machinery	H6009643	10
Unit 312	Understand Agricultural Forage Crop Production	T6009128	10
Unit 313	Understand Agricultural Organic Production	M6009130	10
Unit 314	Understand and Promote Animal Health	D6009365	10
Unit 315	Understand Grassland Management	R6009136	10
Unit 316	Understanding Livestock Breeding and Nutrition	D6009141	10
Unit 317	Undertaking Root Crop and Field Vegetable Production	T6009582	10
Unit 318	Undertake Land-based Industries Pollution and Waste Control Management	L6009801	10
Unit 319	Undertaking Farm Habitat Management	F6009620	10
Unit 320	Undertaking Land-based Machinery Operations	H6009805	10
Unit 321	Undertaking Land-based Workshop Practice	M6009631	10
Unit 322	Undertaking Specialised Land-based Workshop Practices	J6009635	10
Unit 323	Manage Agricultural Environments	F6009133	10
Unit 324	Undertake Dairy Production	K6009580	10
Unit 325	Undertake Beef Production	M6009581	10
Unit 326	Undertaking Pig Production	F6009147	10
Unit 327	Undertaking Poultry Production	J6009148	10
Unit 328	Undertaking Sheep Production	F6009150	10
Unit 329	Mechanised Agricultural Crop Handling and Storage	T6009145	10
Unit 330	Understand the Principles of Animal Biology	J6009389	10

Unit 331	**Participate in Business Planning and Improvement in the Land-based Sector**	**F6009701**	**10**
Unit 332	Understand and Use Agricultural Spreaders and Sprayers	A6009132	10
Unit 333	Fundamentals of Science	R5025536	10
Unit 334	Understand the Principles of Inheritance and Genetic Manipulation	D6009463	10
Unit 335	Chemistry for Biology Technicians	K5025557	10
Unit 336	Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology	J6009439	10
Unit 337	Understand the Principles of Chemistry for Biological and Medical Science	A6009714	10
Unit 338	Understand and Carry Out Farm Livestock Husbandry	L6009457	10
Unit 339	Undertaking Agricultural Combinable Crop Production	R5034916	10
Unit 340	Land Based Engineering Operations – Service and repair Engines and Components	H6003437	10
Unit 341	Understanding and Servicing Land-based Machinery (Cultivation and Planting Machinery)	K6014262	10
Unit 342	Understanding and Servicing Land-based Harvesting Machinery (Cutting and Lifting)	K6014259	10
Unit 343	Understanding and Servicing Mechanical Power Transmission Systems	M6014263	10

Certification/grading modules

City & Guilds unit number	**Title**
910	Certification module for Level 3 Certificate in Agriculture - pass grade
911	Certification module for Level 3 Certificate in Agriculture - merit grade
912	Certification module for Level 3 Certificate in Agriculture - distinction grade
913	Certification module for Level 3 Subsidiary Diploma in Agriculture - pass grade
914	Certification module for Level 3 Subsidiary Diploma in Agriculture - merit grade
915	Certification module for Level 3 Subsidiary Diploma in Agriculture - distinction grade
916	Certification module for Level 3 Diploma in Agriculture - pass grade
917	Certification module for Level 3 Diploma in Agriculture - merit grade
918	Certification module for Level 3 Diploma in Agriculture - distinction grade
919	Certification module for Level 3 Extended Diploma in Agriculture - pass grade
920	Certification module for Level 3 Extended Diploma in Agriculture - merit grade
921	Certification module for Level 3 Extended Diploma in Agriculture - distinction grade
925	Certification module for Level 3 Certificate in Agriculture – distinction* grade
926	Certification module for Level 3 Subsidiary Diploma in Agriculture– distinction* grade
927	Certification module for Level 3 Diploma in Agriculture – distinction* grade

928	Certification module for Level 3 Extended Diploma in Agriculture – distinction* grade
929	Certification module for 90-Credit Diploma in Agriculture – pass grade
930	Certification module for 90-Credit Diploma in Agriculture – merit grade
931	Certification module for 90-Credit Diploma in Agriculture – distinction grade
932	Certification module for 90-Credit Diploma in Agriculture – distinction* grade

5 Registration and Certification

The Level 3 Certificate, Subsidiary Diploma, 90-Credit Diploma, Diploma and Extended Diploma in Agriculture qualifications have been grouped into one programme for registration.

Tutors and Examination Officers should ensure that learners are registered onto 0073-03 and that all 0073-03 documentation for teaching and administration with City & Guilds is used.

When learners' results are submitted to City & Guilds, centres should also submit the relevant Certificate, Subsidiary Diploma, Diploma and Extended Diploma component, according to which units the learner has achieved, so that the appropriate certificate is generated. The overall grade can be calculated using the formula in the assignment guide.

Please note: There are four certification/grading modules for each of the qualifications which differentiates the four grades – pass, merit, distinction and distinction*. Once the overall grade for the assignments has been calculated, the correct certification/grading module needs to be indicated on the results entry.

For example, if a learner achieves the Level 3 Certificate in Agriculture at an overall merit grade, then the certification module 911 needs to be submitted. Please see the Rules of Combination below or the City & Guilds catalogue.

Level 3 Certificate in Agriculture QAN 500/8488/4	
Rules for achievement of qualification	30 credits from (302-303), (307-311), (314-316), (320-322), (324-328), 332,338,339 Plus 910 for certification at pass grade

Level 3 Certificate in Agriculture QAN 500/8488/4	
Rules for achievement of qualification	30 credits from (302-303), (307-311), (314-316), (320-322), (324-328), 332,338,339 Plus 911 for certification at merit grade

Level 3 Certificate in Agriculture QAN 500/8488/4	
Rules for achievement of qualification	30 credits from (302-303), (307-311), (314-316), (320-322), (324-328), 332,338,339 Plus 912 for certification at distinction grade

Level 3 Certificate in Agriculture QAN 500/8488/4	
Rules for achievement of qualification	30 credits from (302-303), (307-311), (314-316), (320-322), (324-328), 332,338,339 Plus 928 for certification at distinction* grade

Level 3 Subsidiary Diploma in Agriculture **QAN 500/8388/0**	
Rules for achievement of qualification	10 credits from 301 **OR** from (302-303), plus a minimum of 50 credits from (301-304), (306-339) Plus 913 for certification at pass grade

Level 3 Subsidiary Diploma in Agriculture **QAN 500/8388/0**	
Rules for achievement of qualification	10 credits from 301 **OR** (302-303), plus a minimum of 50 credits from (301-304), (306-339) Plus 914 for certification at merit grade

Level 3 Subsidiary Diploma in Agriculture **QAN 500/8388/0**	
Rules for achievement of qualification	10 credits from 301 **OR** (302-303), plus a minimum of 50 credits from (301-304), (306-339) Plus 915 for certification at distinction grade

Level 3 Subsidiary Diploma in Agriculture **QAN 500/8388/0**	
Rules for achievement of qualification	10 credits from 301 **OR** (302-303), plus a minimum of 50 credits from (301-304), (306-339) Plus 926 for certification at distinction* grade

Level 3 90-Credit Diploma in Agriculture **QAN 600/6048/7**	
Rules for achievement of qualification	10 credits from 301 **OR** (302-303) plus 80 credits from (301-339) Plus 929 for certification at pass grade

Level 3 90-Credit Diploma in Agriculture **QAN 600/6048/7**	
Rules for achievement of qualification	10 credits from 301 **OR** (302-303) plus 80 credits from (301-339) Plus 930 for certification at merit grade

Level 3 90-Credit Diploma in Agriculture **QAN 600/6048/7**	
Rules for achievement of qualification	10 credits from 301 **OR** (302-303) plus 80 credits from (301-339) Plus 931 for certification at distinction grade

Level 3 90-Credit Diploma in Agriculture QAN 600/6048/7	
Rules for achievement of qualification	10 credits from 301 **OR** (302-303) plus 80 credits from (301-339) Plus 932 for certification at distinction* grade

Level 3 Diploma in Agriculture QAN 500/8487/2	
Rules for achievement of qualification	10 credits from 301**OR** (302-303) plus 20 credits from (304-305), plus 90 credits from (301-303), (306-343) Plus 916 for certification at pass grade

Level 3 Diploma in Agriculture QAN 500/8487/2	
Rules for achievement of qualification	10 credits from 301 **OR** (302-303) plus 20 credits from (304-305), plus 90 credits from (301-303), (306-343) Plus 917 for certification at merit grade

Level 3 Diploma in Agriculture QAN 500/8487/2	
Rules for achievement of qualification	10 credits from 301 **OR** (302-303) plus 20 credits from (304-305), plus 90 credits from (301-303), (306-343) Plus 918 for certification at distinction grade

Level 3 Diploma in Agriculture QAN 500/8487/2	
Rules for achievement of qualification	10 credits from 301 **OR** (302-303) plus 20 credits from (304-305), plus 90 credits from (301-303), (306-343) Plus 927 for certification at distinction* grade

Level 3 Extended Diploma in Agriculture QAN 500/8490/2	
Rules for achievement of qualification	30 credits from (304-306) plus 10 credits from 301 **OR** (302-303), plus 140 credits from (301-303), (307-343) Plus 919 for certification at pass grade

Level 3 Extended Diploma in Agriculture QAN 500/8490/2	
Rules for achievement of qualification	30 credits from (304-306) plus 10 credits from 301 **OR** (302-303), plus 140 credits from (301-303), (307-343) Plus 920 for certification at merit grade

Level 3 Extended Diploma in Agriculture QAN 500/8490/2	
Rules for achievement of qualification	30 credits from (304-306) plus 10 credits from 301 **OR** (302-303), plus 140 credits from (301-303), (307-343) Plus 921 for certification at distinction grade

Level 3 Extended Diploma in Agriculture QAN 500/8490/2	
Rules for achievement of qualification	30 credits from (304-306) plus 10 credits from 301 **OR** (302-303), plus 140 credits from (301-303), (307-343) Plus 928 for certification at distinction* grade

- Learners must be registered at the beginning of their course. Centres should submit registrations using Walled Garden or Form S (Registration), under scheme/complex 0073-03.

- When assignments have been successfully completed results should be submitted on Walled Garden or Form S (Results submission). One of the certification/grading modules 910 to 921 or 925 to 932 need to be submitted to generate the appropriate certificate and grade. Centres should note that results will not be processed by City & Guilds until verification records are complete

- Learners achieving one or more assessment components will receive a Certificate of Unit credit listing the assessment components achieved. Learners achieving the number and combination of assessment components required to meet a defined Rule of Combination will, in addition, be issued with a Full Certificate. Centres must submit a certification/grading component to allow this to happen.

Full details on the procedures for all City & Guilds qualifications registered and certificated through City & Guilds can be found on the City & Guilds on-line catalogue.

Unit 301 Understand Animal Anatomy and Physiology

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of animal anatomy and physiology. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

The aim of this unit is to develop the learner's knowledge and understanding of the structure and function of the main body systems in animals. The learner will also know about the reproductive processes and the role of hormones. Neural and hormonal control mechanisms will also be investigated. The learner will develop an understanding of how the body systems and structures of animals have adapted to meet the needs of different environments.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know the structure and functions of biological systems in animals
2. Know animal reproductive processes
3. Understand the biological control mechanisms in animals
4. Understand how an animal's body structure and systems are adapted to its environment

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

N/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 301 Understand Animal Anatomy and Physiology

Outcome 1 Know the structure and functions of biological systems in animals

Assessment Criteria

The learner can:

1. Identify the **major body systems in animals**
2. Describe the **structure of the major organs in the animal body**
3. Describe the **functions** of the major organs in the animal body

Range

Species should be broadly mammalian but reference to other living organisms to be made where appropriate

Major body systems in animals

Skeletal system: bones, muscles, joints, tendons, ligaments
Respiratory systems: lungs, gills, skin, spiracles and tracheae
Circulatory systems: open and closed, single and double, composition of blood (plasma, erythrocytes, leukocytes, platelets), structure of blood vessels
Lymphatic systems: glands and vessels
Digestive system: dentition, tissue layers of the intestinal wall (lumen, mucosa, submucosa, ducts and submucosal glands, lymph nodes, blood vessels, nerves, circular muscle layer, longitudinal muscle layer, serosa), absorption of nutrients and water.
Excretory system: excretion of ammonia, urea, uric acid.
Nervous system: neurones, Autonomic NS, Central NS, Peripheral NS, sympathetic and parasympathetic, afferent and efferent neurones, reflex arcs
Endocrine system: hypothalamus, thymus, pituitary, thyroid, parathyroid, pancreas, adrenal glands, ovaries, testes,
Reproductive system: male and female systems, oestrus cycle, puberty, gestation and parturition.

Structure and function of the major organs in the animal body

Brain (limited to gross anatomy, optic chiasm and location of hypothalamus and pituitary), lungs, heart, stomach, liver and kidneys

Unit 301 Understand Animal Anatomy and Physiology

Outcome 2 Know animal reproductive processes

Assessment Criteria

The learner can:

1. Describe the structure of the **male and female reproductive system**
2. Describe the functions of the **male and female reproductive system**
3. State the **role of hormones in the mammalian reproductive process**.

Range

Species should be broadly mammalian but reference to other living organisms to be made where appropriate

Unit content

Male reproductive system

Location and functions of: penis (erectile tissue, comparison of penis structure in range of species), urethra, epididymis, vas deferens, testis, spermatogenesis

Female reproductive system

Location and functions of: vagina, cervix, uterus, oviduct, ovary
Comparison of arrangement of female reproductive systems in the range of species Oogenesis and ovulation, stages of oestrous cycle, copulation, fertilisation, gestation, parturition

Role of hormones in the mammalian reproductive process

Oestrogen, progesterone, luteinising hormone, follicle stimulating hormone, oxytocin, testosterone

Unit 301 Understand Animal Anatomy and Physiology

Outcome 3 Understand the biological control mechanisms in animals

Assessment Criteria

The learner can:

1. Examine the **hormonal control mechanisms** in animals
2. Examine **neural control mechanisms** in animals

Range

Species should be broadly mammalian but reference to other living organisms to be made where appropriate

Control mechanisms

Homeostasis, positive and negative feedback loops. Thermoregulation in ectotherms and endotherms

Hormonal

Hypothalamus, pituitary gland, thyroid, thymus, adrenal gland, pancreas, ovary, testes

Requirement of receptors on cell surface, circulating hormones versus locally acting hormones, glucoregulation (insulin and glucagon), osmoregulation (ADH and aldosterone), fight-or-flight response to adrenaline (epinephrine)

Neural

Central Nervous System (brain and spinal cord), Peripheral Nervous System, afferent (conscious and unconscious stimuli, e.g. senses, limb position) and motor (efferent) output: voluntary reactions and autonomic system (sympathetic and parasympathetic actions)

Unit 301 Understand Animal Anatomy and Physiology

Outcome 4 Understand how an animal's body structure and systems are adapted to its environment

Assessment Criteria

The learner can:

1. Explain how the body structure of selected animals are **adapted** to their **environments**
2. Explain how the body systems of selected animals are **adapted** to their **environments**

Range

Species should be broadly mammalian but reference to other living organisms to be made where appropriate

Environmental adaptations

Natural selection and evolution of at least two animals in contrasting environments (e.g. arid, aquatic, cold, hot, high altitudes/flight), adaptation of the following as appropriate: coat and/or skin, sensory organs, limbs and skeleton, digestive system, respiratory system and excretory system (including efficiency), circulatory system, thermoregulation, reproductive system

Unit 301 Understand Animal Anatomy and Physiology

Notes for guidance

This unit is designed to provide the learner with knowledge of the anatomical and physiological systems in animals. Depending on which qualification the unit is delivered through, the context of teaching will differ. The unit should cover a range of species as appropriate to the area of study, with reference to other species where indicated in the specification for purposes of comparison.

Tutors have many opportunities to deliver the unit using a wide range of learning approaches including lectures, discussions, seminar presentations, supervised dissections and live animal handling. Where dissections are used this should be in the context of the centres ethical policies. Tutors should consider integrating the delivery and private study of this unit with other relevant units.

It is expected that learners will be familiar with safe working practices around potentially hazardous equipment, materials and animals. The learner should be taught how to recognise hazards and risks and should also be able to use information to manage potential risks to themselves and others as appropriate.

Outcome 1 covers the main body systems of animals. Delivery of this outcome should cover the structure and functions of the main systems, but tutors should bear in mind that specific systems are covered in further depth in Outcomes 2, 3 and 4 and so should plan delivery/lecture to avoid any unnecessary repetition or duplication. (Note some of the other systems are covered in some depth in the unit Understand the Principles of Animal Biology).

Outcomes 1 and 2 cover the major body systems and reproductive processes in animals. It is expected that learners will observe the organs, through photographs, preserved specimens, or practical dissections. Veterinary operations could also be observed where opportunities allow. All practical work should be supervised and adequate Personal Protective Equipment (PPE) must be used after production of suitable risk assessments. Guest speakers such as veterinarians, veterinary nurses and meat inspectors would contextualise the relevance of the subject for learners. The use of case studies, comparing healthy organs with diseased or injured counterparts, is recommended to help learners understand and relate the organs and systems of the functioning animal body.

Outcome 3 covers the control mechanisms that contribute to homeostasis in the animal body. Independent research leading to group presentations could follow initial tutor input and case studies could be used to illustrate what happens when these tightly regulated systems are compromised by disease or injury.

Outcome 4 will allow the learner to appreciate that the animal body has evolved from selective pressures in the natural environment. These environments should be experienced through the use of audio-visual materials such as Attenborough's 'Life of Mammals'. Learners could carry out independent research using the internet, books and journals, putting together a project comparing and contrasting animals from varying habitats, while visits to zoos or wildlife parks to see more exotic animals would help to illustrate the theory.

References

Books

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Pond, K. & Pond, W., 2000. *Introduction to Animal Science.* J Wiley & Sons Inc.

DVD

Attenborough, D., 2003. Life of Mammals London: BBC.

Websites

www.hse.gov.uk	Health and Safety Executive
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.wales.gov.uk	Welsh Assembly Government
www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.bbc.co.uk/nature/class/Mammal	The BBC nature section focussed on mammals

Unit 302 Understand the Principles of Plant Science

Level: 3

Credit value: 5

Unit aim

This unit aims to provide learners with an understanding of the principles of plant science and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

The learner will have developed an understanding of how plants grow and develop, through knowledge of their structure and physiology.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will:

1. Understand the function of plant structures
2. Understand the main processes of plant physiology
3. Understand plant growth and development

Guided learning hours

It is recommended that **30** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

N/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 302 Understand the Principles of Plant Science

Outcome 1 Understand the function of plant structures

Assessment Criteria

The learner can:

1. Identify the **major internal** and **external structures** of plants
2. Explain the **function** of the major plant structures

Unit content

Major internal structures

Cell structure (cytoplasm, organelles), parenchyma, collenchyma, sclerenchyma, xylem tissue, phloem tissue, cambium, epidermis, guard cells, and stomata

Major external structures

Root, shoots, stem, leaves, buds, flower, fruit, and seed
Specialised internal and external structures, for example pericycle, endodermis, lenticels, cotyledons, stolons, rhizomes, storage organs

Function

Photosynthesis, reproduction, support, transport, anchorage, absorption, storage, defence, attraction, aeration, respiration, division

Unit 302 Understand the Principles of Plant Science

Outcome 2 Understand the main processes of plant physiology

Assessment Criteria

The learner can:

1. Explain the major **processes** of plant physiology
2. Identify the **factors** which can **limit** the rate **of photosynthesis**

Unit content

Processes

Photosynthesis: process (equation) for photosynthesis, function of chlorophyll, functionality of guard cells and stomata, factors needed for photosynthesis to occur (light, chlorophyll, carbon dioxide, water)

Respiration: definition of aerobic and anaerobic respiration, equation for aerobic respiration, structure and function of mitochondria, diffusion, compensation point, factors influencing the rate of respiration (temperature, water availability, seasonal growth)

Uptake, transport and loss of water and nutrients: osmosis, diffusion, plasmolysis, turgor, translocation, transpiration, factors influencing transpiration (temperature, humidity, air movement, water supply, light, stomata)

Limiting factors of photosynthesis

Temperature, carbon dioxide, leaf colour, light, water availability

Unit 302 Understand the Principles of Plant Science
Outcome 3 Understand plant growth and development

Assessment Criteria

The learner can:

1. Explain the **life cycle** of selected plants

Unit content

Life cycle

Life cycle types (ephemeral, annual, biennial, perennial), process and stages of germination, types of germination (epigeal, hypogeal), types of reproduction (sexual reproduction, for example flower structures, pollination and fertilisation, seed production, dispersal), (asexual reproduction, for example vegetative propagation, parthenogenesis), primary growth of shoots and roots (cell division, cell expansion, cell differentiation, apical meristems, lateral meristems)

Unit 302 Understand the Principles of Plant Science

Notes for guidance

On completion of this unit, the learner will have developed an understanding of how plants grow and develop, through knowledge of their structure and physiology. It will be important that delivery relates to plants that are vocationally relevant to the learners- e.g. production crops for agriculture. Laboratory based practicals could help learners to explore plant physiology and structure, and a series of visits to growing crops could help learners better understand plant growth and development. Learners are required to study a range of monocotyledon and dicotyledon plants for this unit.

Outcome 1 requires the learner to identify the main internal and external structures of both monocotyledon and dicotyledon types of plants and to explain the function of the main plant structures. The outcome is mainly theory based and can be delivered by formal lectures, discussion, internet research and directed study.

Outcome 1 and 2 are directly linked as outcome 2 identifies the need for learners to explain the major processes of plant physiology and identify factors affecting photosynthesis. Learners may find it useful to undertake practical sessions, habitat surveys or site visits to a range of habitats to learn more about plant physiology and factors affecting photosynthesis.

Outcome 3 requires the learner to explain the life cycle of plants which again can be linked into outcome 1 and 2 with careful planning. Learners should visit sites where plants can be studied at appropriate development stages i.e. at different times of the year. Formal lectures, directed study and research will be required to enhance the learners understanding of the complexities of plant physiology and life cycles. It is important that a risk assessment is carried out prior to any practical activity and that suitable Personal Protective Equipment (PPE) is provided.

Visiting speakers e.g. agronomist, rangers or plant breeders could enhance relevance of the subject to learners. Work experience may be beneficial to learners looking to develop careers in the field. Development of areas within a College environment where learners are able to modify and manipulate plant environments may enhance understanding of the complexities of plants and their life cycles

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Books

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Unit 303 Understand the Principles of Soil Science

Level: 3

Credit value: 5

Unit aim

This unit aims to provide learners with an understanding of the principles of soil science. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

This unit aims to develop the learners understanding of soil characteristics, and their relationship to crop growth and development.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will:

1. Be able to investigate soil characteristics
2. Understand how soil characteristics affect plant growth and development
3. Understand how soil characteristics affect plant selection

Guided learning hours

It is recommended that **30** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

n/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 303 Understand the Principles of Soil Science

Outcome 1 Be able to investigate soil characteristics

Assessment Criteria

The learner can:

1. Compare the **characteristics** of different **soil types**
2. Carry out **experiments** to determine the characteristics of a soil sample

Range

Soil types

Loams, clays, silts, sands, organic soils

Unit content

Characteristics

Properties of soil particles (clay, silt, sand), water holding capacity, aeration, stability, organic matter, pH, soil structure (crumb structure, aggregate sizes)

Experiments

Laboratory based tests (water holding capacity, soil pH, proportion of clay, silt and sand, nutrient content)

Unit 303 Understand the Principles of Soil Science

Outcome 2 Understand how soil characteristics affect plant growth and development

Assessment Criteria

The learner can:

1. Explain how **soil type and condition** affect plant growth and development
2. Explain how **soil structure and drainage** can **affect plant growth** and **development**.

Range

Soil types

Loams, clays, silts, sands, organic soils

Unit content

Soil condition

Stability, availability of macronutrients (nitrogen, phosphorous, potassium), micronutrients (for example iron, copper, manganese), nutrient retention, water retention and availability, effects of organic and inorganic fertiliser application, pH and organic matter

Effects of soil structure and drainage on plant growth and development

Rooting depth, availability of plant nutrients, drainage, water logging, compaction, effects of high soil water content (reduced oxygen availability, poor plant growth), effects of water availability to plants, effects on ability to cultivate

Unit 303 Understand the Principles of Soil Science

Outcome 3 Understand how soil characteristics affect plant selection

Assessment Criteria

The learner can:

1. Explain how **cultural techniques** affect **soil characteristics**

Range

Soil types

Loams, clays, silts, sands, organic soils

Unit content

Cultural techniques

Crop/plant rotations and crop/plant choice, nitrogen fixation

Cultivations: ploughing, minimal cultivation techniques, zero cultivation, subsoiling

Establishment: broadcasting, transplanting, precision seeding, direct drilling, use of green manures and muck inclusion

Crop maintenance: spraying and fertiliser application, damage by machine and its reduction

Harvesting and seasonality: harvesting damage

Soil characteristics

Proportions of sand, silt, clay, organic matter content, water holding capacity, air, permeability, pH, porosity

Plant life and earth worm populations

Compaction capping and smearing

Unit 303 Understand the Principles of Soil Science

Notes for guidance

This unit aims to provide learners with an understanding of the interrelationship between soil characteristics and crop growth and development, and explores soil characteristics through investigative experiments. As learners will be engaged in practical activity there should be an emphasis on safe working practices, including the use of appropriate Personal Protective Equipment (PPE), and appropriate risk assessments should be undertaken. At Level 3 it is expected that learners will take an active part in completing risk assessments, so that this becomes an integral part of all practical activity.

Delivery of this unit will involve classroom based activity, laboratory experiments and visits to sites with different soil characteristics, preferably also with a range of crop types. It is likely that learners will also need to undertake independent study and research.

In Outcome 1, learners will need to investigate a range of soil types and carry out supervised basic soil experiments to identify different soil characteristics. These could include investigating the proportion of sand, silt and clay through suspending in water, investigating the water holding capacity of different soil types, and determining soil pH.

For Outcome 2, learners will need to develop an understanding of the effects of soil characteristics on crop growth and development. This could be supported by some controlled experiments, where learners grow plants in different soil types. Delivery of this outcome could also be enhanced by visits to see different types of crops growing in different soil types. Visiting expert speakers, such as soil scientists or agronomists, could be useful, and could describe practical aspects of managing soil structure and plant nutrition.

Outcome 3 covers the effect that choice of crop has on soil characteristics, which is the basis of crop rotation principles. Delivery will include consideration of the range of consequential effects of crop choice i.e. methods of planting and harvesting, use of machinery, crop requirement for supplementary nutrients. Delivery is likely to include both classroom activity and site visits, and could be linked to learners' work placements. A guest speaker, particularly one able to discuss the relative merits of crop rotation, would add further vocational interest.

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Journals

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Websites

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www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.wales.gov.uk	Welsh Assembly Government
www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.hse.gov.uk	Health and Safety Executive
www.lantra.co.uk	Lantra SSC
www.pda.org.uk	Potash Development Association
www.rothamsted.ac.uk	Rothamsted Research
www-saps.plantsci.cam.ac.uk	The Science and Plants for Schools Website
www.soils.org.uk	British Society of Soil Science

Unit 304 Undertake an Investigative Project in the Land-based Sector

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of undertaking an investigative project and how this can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

The learner will develop project knowledge and skills by investigating a chosen topic area through a project. They will explore topic areas that interest them and select one topic for their investigative project. They will plan and carry out their investigative project working to meet deadlines and monitoring performance. The learner will prepare an evaluative report looking at how the project performed, if the schedule plan met the project aims and objectives and how improvements could be made in the future.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Be able to identify and research a suitable topic for an investigative project in the environmental and land-based sector
2. Be able to plan for an investigative project in the environmental and land-based sector
3. Be able to carry out an investigative project in the environmental and land-based sector
4. Be able to report on an investigative project in the environmental and land-based sector

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

n/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 304 Undertake an Investigative Project in the Land-based Sector

Outcome 1 Be able to identify and research a suitable topic for an investigative project in the environmental and land-based sector

Assessment Criteria

The learner can:

1. List **information sources** relevant to the topic to be researched
2. Carry out **research** into potential topics
3. **Select and describe** a relevant investigative project topic in the environmental and land-based sector
4. **Prepare a proposal** for an investigative project

Range

The topics for the investigative project should reflect both learner interest and the qualification undertaken.

Unit content

Information sources

For example textbooks, journals, magazines, internet, trade literature, television and radio, subject experts, validity and reliability

Research

Methods appropriate to the project, e.g. literature review, trials, experiments, practical activities, questionnaires, interviews, surveys

Select and describe

Suitable project topic (e.g. trial or experiment, investigation of an issue important to the sector, preparation of a plan, production of a structure or artefact, training programme, preparation for and participation in a competition, improving a process, investigation of a new product or service). Justify the selection of the project topic in relation to e.g. programme of study, interests and experience, future employment ambitions, comparison with alternative topics

Prepare a proposal

Title, aims/ objectives, methodology, information sources, resources (e.g. people, computers, materials, etc. required for completion of the project), justification of proposed project

Unit 304 Undertake an Investigative Project in the Land-based Sector

Outcome 2 Be able to plan for an investigative project in the environmental and land-based sector

Assessment Criteria

The learner can:

1. **Plan operations and resources** required to carry out a selected investigative project in the environmental and land-based sector
2. Explain the **reasons** for resources selected

Range

The topics for the investigative project should reflect both learner interest and the qualification undertaken.

Unit content

Plan operations

Project planning techniques (e.g. critical path analysis, Gantt charts), sequencing of activities, working to deadlines, allowing for other commitments, project action plan: aims, objectives, specific operations / tasks, start and completion dates, time required, resources required, possible disruptions to plan (e.g. illness, other commitments, resource problems, IT problems, research problems, lack of cooperation, cost), contingencies and remedial actions

Resources

People, time, buildings, equipment, animals, materials, literature and media (internet, trade magazine), IT applications and budget

Reasons

Suitability, availability and cost

Unit 304 Undertake an Investigative Project in the Land-based Sector

Outcome 3 Be able to carry out an investigative project in the environmental and land-based sector

Assessment Criteria

The learner can:

1. **Carry out a selected investigative project** in the environmental and land-based sector
2. **Monitor progress**, working to **deadlines**
3. Discuss the **health and safety implications** of the investigative project

Range

The topics for the investigative project should reflect both learner interest and the qualification undertaken.

Unit content

Carry out a selected investigative project

Suitable project as proposed in outcome 1(trial or experiment, investigation of an issue important to the sector, preparation of a plan, production of a structure or artefact, training programme, preparation for and participation in a competition, improving a process, investigation of a new product or service). Implementation (set up, start), operations (tasks, duties), evidence of actions e.g. literature review, artefacts, plans, presentations, witness statements, photographs or videos

Monitor progress

Diary or log of actions, monitoring of performance against schedule plan e.g. daily, weekly, monthly progress, budget, other appropriate measures for each resource or task, reasons and remedial actions if falling behind schedule

Deadlines

Interim, key mileposts, final, all to be reviewed at regular intervals by tutor

Health and safety implications

Health and safety, risk assessment, Personal Protective Equipment (PPE), relevant regulations and legislation, animal welfare, codes of practice

Unit 304 Undertake an Investigative Project in the Land-based Sector

Outcome 4 Be able to report on an investigative project in the environmental and land-based sector

Assessment Criteria

The learner can:

1. **Report** on a selected investigative project in the environmental and land-based sector
2. **Evaluate achievements and areas for improvement** of a selected investigative project

Range

The topics for the investigative project should reflect both learner interest and the qualification undertaken.

Unit content

Report

Report on the project selected and completed in outcomes 1-3. Written report format, oral report presentation, title, aims/objectives, review of existing literature/information, methodology, results/findings (with appropriate evidence, e.g. charts and graphs, diagrams, photographs), conclusions, Harvard referencing

Evaluate achievements

Conduct and management of the project, action plan, keeping to deadlines, problems and remedial actions, project results/findings, strengths and weaknesses

Areas for improvement

Planning, implementation, methodology, results/findings, report, topics for further investigation

Unit 304 Undertake an Investigative Project in the Land-based Sector

Notes for guidance

This unit is designed to encourage and develop independent research skills in learners provides valuable skills development for all level 3 learners and especially those looking to progress onto Higher Education. The concept of the project is applicable across all of the vocational areas in the environmental and land-based sector, and learners should be guided and encouraged to select a project topic that is particularly relevant to their interests. This could integrate with other units in their programme of study. The emphasis of the unit should be on project management and working to deadlines, as well as producing a meaningful investigative project. Much of the work will be carried out independently by learners but they must have access to appropriate tutor guidance and support.

In Outcome 1, learners will need to identify a suitable topic for their investigative project. This should be relevant to their programme of study and have a particular interest for them, for example in relation to a special area of interest, experience or future employment of study ambitions. Ideal project topics could have a practical or theoretical focus, but all projects should include potential for research into existing literature and information sources as well as a practical investigation or application, so should be chosen in agreement with the tutor. Learners are likely to need guidance on suitable project topics and tutor support to ensure that selected topics are achievable in the timescale and with the resources available. The proposal should outline the aims and objectives, information sources, resource requirements, and the methodology by which the learner intends to complete the project, as well as their justification for topic selection. If appropriate to the investigation, a hypothesis should be included as part of the methodology.

In Outcome 2, learners will need to complete a detailed action plan for completion of the investigative project within the set timescale. This should include, as a minimum:

- a detailed breakdown of all actions from starting the project up to submission of the completed project report
- resources required at each stage (and reasons for their selection)
- time expected for completion and interim target completion dates.

They should also consider possible setbacks to their planned schedule and contingency plans to ensure timely completion of the project. Learners are likely to require guidance on project planning techniques and how to compile an appropriately detailed action plan. They could be provided with a suitable template.

In Outcome 3, learners will conduct and complete their investigative project, collecting supporting evidence as appropriate, for example literature review, artefacts, witness statements, photographs or videos, etc. Whilst doing this, they should maintain a log or diary of all actions, and regularly monitor their progress against their action plan. It would be appropriate for tutors to conduct progress reviews at key stages of the project. As part of conducting the project, learners should discuss any health and safety implications of their work to humans and, if appropriate, animals, and identify any relevant legislation or codes of practice. Risk assessments may contribute to evidence of this.

In Outcome 4, learners will produce a summary report of their project and the process of its completion. This should cover, as a minimum:

- title
- aims / objectives
- review of existing literature / information
- methodology
- results / findings
- conclusions
- references

All referencing should comply with academic conventions, and learners should be given appropriate guidance on this.

The project evaluation should consider the strengths and weaknesses of the finished project and the process of its completion, the usefulness and importance of project planning, and ways in which the project could have been improved.

Some parts of the project report could be presented orally rather than in written report format.

References

Books

Applegarth, M. 1998. *The Project Management Pocketbook*. Alresford: Management Pocketbooks.

Nokes, S., Kelly, S. 2007. *The Definitive Guide to Project Management: The Fast Track to Getting the Job Done on Time and on Budget.* 2nd ed. Harlow: Financial Times Prentice Hall.

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Unit 305 Undertake and Review Work Related Experience in the Land-based Industries

Level: 3

Credit value: 10

Unit aim:

The aim of this unit is to give learners the skills needed to identify, participate in and review work experience in the environmental and land-based sector. The unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand the opportunities in the environmental and land-based industries
2. Be able to prepare for a work-based experience in the environmental and land-based industry
3. Be able to undertake a work-based experience in the environmental and land-based industry
4. Be able to review a work-based experience in the environmental and land-based sector

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

N/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 305 Undertake and Review Work Related Experience in the Land-based Industries

Outcome 1 Understand the opportunities in the environmental and land-based industries

Assessment Criteria

The learner can:

1. Evaluate **career and progression opportunities** within an environmental and land-based industry

Unit content

Career and progression opportunities

Job roles relevant to the sector: managerial, supervisory, team worker, trainee, volunteer, common job titles within the relevant sector, main duties and responsibilities

Skills needed to fulfil duties and responsibilities of appropriate jobs: job specific, vocational and personal

Progression pathways from trainee or team worker positions to supervisory and management posts. Skills, qualifications and experience required to achieve career progression

Evaluate career and progression opportunities: advantages and disadvantages of identified pathways, suitability to personal interests, skills and qualifications, role of work experience in preparing for a selected career

Unit 305 Undertake and Review Work Related Experience in the Land-based Industries

Outcome 2 Be able to prepare for a work-based experience in the environmental and land-based industry

Assessment Criteria

The learner can:

1. **Select** an appropriate work-based experience and complete the **application process**
2. Demonstrate **interview skills** as an interviewee
3. Prepare for a work-based experience, identifying **targets, aims and objectives**

Unit content

Select

Suitable work experience position based on existing skills, experience, qualifications, development of skills and experience to achieve future employment goals

Application process

Finding suitable job opportunities from e.g. trade magazines, websites, employer approaches to the centre, completion of an application form, curriculum vitae and letter of application

Interview skills

Interview preparation: Research the business and job role, suitable dress and personal presentation, information to find out and suitable questions to ask. Interview performance: attend punctually and dressed appropriately, answering questions, completion of other tests (e.g. practical, aptitude), and reflection on interview performance

Targets, aims and objectives

Aims: overall impact of work experience on skills, experience, future employability, targets / objectives, specific development of workplace skills and knowledge (e.g. technical, vocational, business, team working, communication and employability)

Unit 305 Undertake and Review Work Related Experience in the Land-based Industries

Outcome 3 Be able to undertake a work-based experience in the environmental and land-based industry

Assessment Criteria

The learner can:

1. **Undertake** a selected appropriate work-based experience
2. Maintain a **record of activities and achievements** during a work-based experience.

Unit content

Undertake

Completion of 300 hours of appropriate work experience, attend punctually and reliably, work competently and in line with job role requirements, health and safety, security, confidentiality, effective working relationships with colleagues, supervisors and customers.

Record of activities and achievements

Job description for work role, main duties and responsibilities, regular daily working routine, diary of additional tasks, duties, learning experiences portfolio of work experience (e.g. photographs, witness statements, work experience provider's or assessor's reports, progress reviews)

Unit 305 Undertake and Review Work Related Experience in the Land-based Industries

Outcome 4 Be able to review a work- based experience in the environmental and land-based sector

Assessment Criteria

The learner can:

1. **Present evidence** of activities and achievements during a work-based experience
2. **Review** a work-based experience, identifying strengths and areas for improvement

Unit content

Present evidence

Name of work experience provider, nature of the organisation (type of business, products or services, customers), organisation structure chart, job description for work role, main duties and responsibilities, regular daily working routine, health, safety and welfare of employees, customers, animals, diary of additional tasks, duties, learning experiences, portfolio of work experience (e.g. photographs, witness statements, work experience provider's or assessor's reports and progress reviews)

Review

Business effectiveness: products and services, physical resources (e.g. buildings, machinery, equipment), business procedures, staff management and supervision, employees' skills and development, marketing and customer relations, personal workplace effectiveness: work speed, work quality, punctuality, attendance, reliability, dress and personal presentation, working relationships with peers, working relationships with supervisor, work experience aims, objectives and targets, impact of work experience on future career ambitions

Unit 305 Undertake and Review Work Related Experience in the Land-based Industries

Notes for guidance

Learners on vocational courses should have experience of the type of work that they hope to do, and of the expectations of potential future employers. Many Level 3 learners are likely to have already had experience of working in the land-based and environmental industries, so this unit seeks to provide new experience opportunities for these learners.

Ideally this unit should be undertaken in a real business environment relevant to the subject interest of the learner, but actual work experience may be gained by a number of routes, e.g. as part of an industrial placement whilst within the programme, whilst working on a planned daily or weekly basis on the centre's commercial and/or educational facilities, whilst undertaking voluntary work within the industry, as previous relevant and current work experience in the industry or as a member of a group of learners invited to carry out practical work on a suitable business.

Throughout the unit, the emphasis should be on safe working. It is expected that learners will be aware of safe working practices and familiar with accepted practices and behaviours within the context in which they are working.

Learners should complete the equivalent of 8 weeks (or 300 hours) work experience to achieve this unit. If work experience is in the industry, centres should be mindful of their responsibilities for ensuring that work placements have appropriate supervision, insurance and health and safety policies in place.

In Outcome 1, learners will explore the different job roles and responsibilities, and the job titles commonly associated with them in their specialist sector. This background understanding is likely to require some formal classroom teaching, and may be closely linked to material in the unit "Business Management". Learners should be encouraged to explore the range of employment opportunities and career paths within their specialist sector. It would be appropriate for employers to be invited to outline to learners their expectations in the workplace. Learners will then consider the skills and qualifications that are required for appropriate jobs for themselves and should be encouraged to think about skills and qualifications that they may need to acquire to achieve their employment and careers ambitions. Evaluation of career and progression opportunities should include advantages and disadvantages of at least 3 possible career pathways within their specialist sector. This should help them to identify suitable work experience.

Outcome 2 involves learners going through the process of applying for work experience. They will need to locate suitable job adverts or work experience opportunities, but can be supported by centres suggesting suitable placements. When applying for work experience learners should produce, as a minimum, a detailed curriculum vitae and letter of application using a computer. Learners may need to be given supported workshop time on computers to develop these documents. Before attending for a work experience interview it would be appropriate for learners to role play an interview and be given feedback on their interview technique. After attending for an interview they should reflect on their performance and how they could improve their effectiveness. Before commencing work experience they should set overall aims to be achieved during the period and SMART (specific, measurable, achievable, realistic, timescaled) targets or objectives for learning and improvement in relation to future career aims.

Outcome 3 requires that learners effectively complete their period of work experience, meeting the requirements of the workplace appropriate for their position. It would be advisable for their progress to be reviewed at least once during the period and they should have access to tutor support in case of difficulties arising. During their work placement learners must produce the details

of their job role and working routine, maintain a diary at least weekly and collate other relevant information on their work placement, performance and achievements. It would be appropriate for tutors to complete a report in consultation with the work experience provider mid-way and at the end of the placement.

In Outcome 4, learners will use evidence from outcome 3 to present a report, oral and/or written, on their work experience business, job role, learning and achievements. They will then review the effectiveness of the workplace, making realistic and justified suggestions for improvement. Review of their own workplace performance and achievements should include all of the content identified, with reference to relevant evidence, e.g. reports, progress reviews, and the extent to which their aims, objectives/targets have been achieved. Learners should consider further training and experience that will help them to achieve their career ambitions.

Unit 306 Business Management in the Land-based Sector

Level: 3

Credit value: 10

Unit aim

The learner will look at the business, the role and responsibilities of those employed in land-based businesses and resource requirements. They will develop their skills in business operations and produce a business plan.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know the breadth and importance of an industry in the environmental and land-based sector
2. Understand business resources and structures
3. Understand the business marketplace
4. Understand how to use financial and physical record keeping systems

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

n/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 306 Business Management in the Land-based Sector

Outcome 1 Know the breadth and importance of an industry in the environmental and land-based sector

Assessment Criteria

The learner can:

1. Describe the **importance** of businesses within the industry **to the economy**
2. Outline the range of **associated businesses** allied to the industry

Unit content

Importance to the economy

Using measures available to the industry, e.g. value of output, contribution to Gross Domestic Product (GDP), employment, land use, economic and social benefits, trends in importance

Range of organisations: typical types of businesses and other organisations (e.g. representative, regulatory, not-for-profit) within the sector, regional variations, changes and developments in the last 50 years

Associated businesses

Relevant industries in primary, secondary and tertiary industrial sectors (e.g. suppliers of raw materials, processors, distributors, retailers, service providers)

Associated organisations: specific interrelationships between one business and other associated organisations e.g. suppliers of goods and services, representative organisations and professional bodies, regulatory bodies, competitors, customers, aims and roles of important organisations in the sector

Unit 306 Business Management in the Land-based Sector

Outcome 2 Understand business resources and structures

Assessment Criteria

The learner can:

1. Explain the **legal structure and organisation** of a land-based business
2. Explain the **physical resource requirements** of a selected land-based business
3. Describe different **job roles and responsibilities** in a selected land-based business

Unit content

Legal structure and organisation

Features of the main business types, e.g. sole trader, partnership, limited company, not-for-profit organization, charity, public sector organisations, organization staffing structure

Physical resource requirements

Property (forms of tenure, appraisal of business potential), vehicles and machinery, tools and equipment, stocks (stock control procedures), insurance of physical resources

Job roles and responsibilities

Job roles relevant to the sector, e.g. director, manager, supervisor, team worker, trainee, administrator, volunteer, sub contractor, job title, job description, responsibilities for financial, physical and human resources, staff motivation and performance management, person specification (typical skills, qualifications and experience required to fulfil the role), legal rights and responsibilities in work (e.g. pay, working hours, holidays, equal opportunities, health and safety, employment protection), relevant employment legislation

Unit 306 Business Management in the Land-based Sector

Outcome 3 Understand the business marketplace

Assessment Criteria

The learner can:

1. Describe the **marketplace, customers and competitors** for a land-based business
2. Explain features of an efficient **supply chain** in a land-based context
3. Review **quality management** systems and practices within a land-based business

Unit content

Marketplace, customers and competitors

Size of market (e.g. value of sales, number of customers), external influences on the market (political, economic, socio-cultural, technological), customer base (number, type, characteristics, market segments), direct and indirect competitors, competitor analysis, market share

Supply chain

Suppliers, distributors, customers, choosing suppliers, ensuring supplies of inputs, supply chain assurance (e.g. environmental, animal welfare)

Quality management

Important aspects of quality in the sector, formal quality standards or approval (e.g. Farm Assured, ISO 9000, BHS approval), informal systems and practices to achieve quality, problems arising if quality is not achieved

Unit 306 Business Management in the Land-based Sector

Outcome 4 Understand how to use financial and physical record keeping systems

Assessment Criteria

The learner can:

1. Review **financial records** for a selected land-based business
2. Examine **physical records** for a selected land-based business
3. Examine the use of financial and physical records in **monitoring business performance and progress**

Unit content

Financial records

Importance of keeping accurate records (legal requirements and management efficiency), purchasing and ordering procedures, order forms and orders, deliveries and receipts, invoices and sales records, credit control, payment methods, bookkeeping (cash analysis, petty cash, cash flow, budgets, computer accounts programmes), basic accounts (trading account, balance sheet, depreciation), taxation (VAT, income tax PAYE, national insurance contributions, corporation tax), wage calculation

Physical records

Records appropriate to the industry relating to e.g. production, inputs, staffing, customers, resource use, data protection, legal requirements to keep records, e.g. pesticide use, veterinary medicines, transport, animal movement, passports

Monitor business performance and progress

Use of financial and physical records to monitor business performance, e.g. production levels, costs of production, financial efficiency, monitoring against targets, budgets, previous periods, relevant review periods (e.g. weekly, monthly, annually), appropriate remedial actions, staff roles in recording and analysing information

Unit 306 Business Management in the Land-based Sector

Notes for guidance

This unit is designed to provide the learner with an understanding of the business aspects of their industry. It is applicable to all sectors of the environment and land-based sector and learners focus their study on the sector most relevant to their vocational interests.

In Outcome 1 they will investigate the size, scope and importance of their specialist sector within the environment and land-based industries, and how this has developed over the last 50 years or so. For some sectors this type of information is more readily available than other (e.g. agriculture), so learners should be supported in accessing whatever information is available relevant to their sector. They will also investigate the range of business types and other organisations that are represented in their sector, including important regulatory, professional or representative organisations. Wherever possible this should be related to specific businesses and organisations. This outcome is likely to require formal teaching, which should be supported by relevant information on businesses and organisations within the sector, and could include speakers representing these. Independent study and investigation should also be encouraged.

Outcome 2 focuses on the legal and resource implications of constituting a business. They will learn about the range of business organisations in the private and public sectors, and the legal and practical implications of different business types. This should be related to the types of business important in their sector. Learners will investigate the physical resource requirements of businesses, and how they are managed. It would be appropriate for learners to undertake a case study on a business premises in their sector and appraise its strengths and weaknesses for a given business use. The understanding that learners will gain on job roles and responsibilities has links with the requirements for Work Experience, and employers could be invited to explain their expectations in the workplace. The learners' investigations should focus on job roles within their specialist sector.

In Outcome 3 learners will analyse the market for a specific land-based business. This could involve a case study project and should identify, for that business, information on the content listed. External influences should be relevant and current to that business. Specific competitors should be identified and analysed to identify strengths and weaknesses to the case study business. When investigating the supply chain learners will need to identify the flow of resources from production of raw materials, through relevant manufacture and processing, to end consumers. Quality management will include reference to any formal standards or approvals that are relevant. It should also consider the quality standards required by the industry, any systems and practices that are used to achieve quality, and implications of failing to meet prescribed or assumed levels of quality. This should be related to specific businesses and teaching could again be supported by relevant visiting speakers from industry.

Outcome 4 focuses on the range of financial and physical records that are required to meet legal requirements as well as to ensure effective business operation. Learners will need to be able to complete simple examples of the range of financial records listed. They should be aware of paper-based and computerised systems for financial records but are not expected to become competent in the use of IT accounts software. The range of physical records investigated should be related to the needs of the learners' specialist sector, and should include important current examples of legally required records. This content could link with other specialist vocational units. In addition to completing a range of records, learners will investigate how specific examples can be used to aid decision making, monitor and control business performance.

Centres are encouraged to introduce employers and specific professionals from industry to provide interesting and relevant information to the learner. Teaching would also benefit from visits to a variety of establishments to add depth to the learner experience.

It is accepted that formal lectures will be necessary at level 3 but for this unit it is recommended that they are they are linked directly with interactive lessons in a real environment.

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Unit 307 Undertake Agricultural Crop Production

Level: **3**

Credit value: **10**

Unit aim

This unit aims to introduce learners to the skills and knowledge need for agricultural crop production and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/education.

The aim of this unit is to develop learners' understanding of factors affecting the profitability of crop production as well as the practical skills required to establish and monitor crop growth

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know how to establish crops
2. Be able to plan the growth of crops
3. Understand how to harvest and store crops
4. Understand production costs and markets

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

AgC9 Prepare, monitor and cultivate sites for planting crops
AgC10 Promote, monitor and maintain the healthy growth of extensive crops
AgC11 Prepare planting equipment and plant extensive crops
AgC12 Control the harvesting of extensive crops by mechanical means

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SCC

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 307 Undertake Agricultural Crop Production

Outcome 1 Know how to establish crops

Assessment Criteria

The learner can:

1. **Identify appropriate crops** and varieties
2. Select appropriate **equipment for seedbed preparations**
3. Identify correct **planting specifications**
4. Describe a **crop rotation** suitable for a **given soil type**

Unit content

Crops

Cereals, oilseeds, grass, peas, beans, alternative crops

Identify appropriate crops

Recognise seeds and their growth in field at all stages, named varieties for different uses (milling, malting, bio-fuel and seed)

Equipment for seedbed preparation

Subsoil, moledrain, conventional machinery (plough, disc), non-inversion tillage machinery, match to tractor size, match equipment to soils and timing of use.

Planting specification

Timing of drilling, crop seedbed, expected yield, soil type, seed rate, depth, row width and spacing, plant population, thousand grain weight (TGW).

Crop rotations

Reasons for crop rotations, restorative and exhaustive crops, Norfolk 4 course, continuous cropping, break cropping, catch cropping, roots, set-aside

Given soil type

Clay, sand, loam, silt

Unit 307 Undertake Agricultural Crop Production

Outcome 2 Be able to plan the growth of crops

The learner can:

1. Plan a **fertiliser programme** for named **crops**
2. Describe **weed, pest and disease control procedures** appropriate to the production of a named crop
3. Describe correct **legislative and environmental guidelines**

Unit content

Crops

Cereals, oilseeds, grass, peas, beans, alternative crops

Fertiliser programme

Major and minor nutrients (nitrogen, phosphate, potassium, sulphur, manganese), timing of applications (drilling, spring split applications), lime, manure applications

Weed, pest and disease control procedures

Recognise weeds, diseases and pest damage, types of herbicide, fungicide, pesticide, plant growth regulators, application according to crop growth stages and use of UK Pesticide guide

Legislative and environmental guidelines

Environmental Protection Act 1990, Cross Compliance Nitrates Directive 1991, Water Framework Directive 2003, Local Environmental Risk Assessment Procedures (LERAPs), Nitrate Vulnerable Zones (NVZ's) and timing, Entry Level Scheme rules, Defra good practice guidance, for example Protecting our Water, Soil and Air: A Code of Good Practice for farmers, growers and managers (the "CoGAP").

Unit 307 Undertake Agricultural Crop Production

Outcome 3 Understand how to harvest and store crops

Assessment Criteria

The learner can:

1. Explain **harvesting operations** for **named crops**
2. Discuss suitable **storage conditions** for named crops
3. Evaluate **control methods for storage pests and diseases**

Unit content

Crops

Cereals, oilseeds, grass, peas, beans, alternative crops

Harvesting operations

Timing and crop maturity, crop flow through machine, pre-harvesting operations (swathing, topping), field settings and adjustments to machine (minimise crop damage, straw chopping and spreading)

Storage conditions

Crop store preparation, crop moisture during storage, crop dryer settings and adjustments

Control methods for storage pests and diseases

Recognise pests, appropriate chemicals (smoke, traps, UK pesticide manual), types of vermin control (birds, rats)

Unit 307 Undertake Agricultural Crop Production

Outcome 4 Understand production costs and markets

Assessment Criteria

The learner can:

1. Evaluate **market requirements**
2. Analyse **crop yields**
3. Compare market prices
4. Compare **production costs** for different crops

Unit content

Crops

Cereals, oilseeds, grass, peas, beans, alternative crops

Market requirements

The various end uses for the crops (milling, malting, seed, bio fuel, feed), quality standards (Hagberg falling number, protein, impurities, moisture content, appearance), crop assurance schemes

Crop yields

Average yields for the crops, reasons for yield differences and losses, use comparison data for analysis, for example Cambridge university data, The Arable Group (TAG)

Production costs

Variable costs (seeds, fertilisers, sprays), fixed costs (machinery, depreciation, labour, fuel), unit costs, compare contractor's costs, gross margin data

Unit 307 Undertake Agricultural Crop Production

Notes for guidance

The delivery of this unit will involve practical delivery, theory sessions, visits to suitable locations and will have links to industrial experience placements. This unit focuses on the learner being involved in all the operations of farm combinable crop production and will imitate industry practice. Tutors need to offer the learner as wide a selection of learning opportunities as possible. This will involve lectures, regular crop walks, (both in taught time and learners' own time) farm practical work experience, talks, visits (local machinery dealers), and use of an agronomist if possible. For the unit to be effective, tutors will need to choose carefully the timing of the assessments because of the importance of seasonality. In addition, the tutor needs to ensure that all relevant crops are included; this should include cereals, grass, oil-seed rape, peas, beans, and "alternatives" such as linseed. Other crops according to locality could be used at the tutor's discretion. Learners will need access to farm recording data and relevant previous crop history.

Outcome 1 will need to be delivered at the start of the unit, such as in the autumn. Learners may well have been working and involved in autumn cultivations and seedbed preparation. Tutors will need to arrange for learners to be practically involved in field cultivations, especially where the learner has very limited experience. Crop walks at this time of year will be primarily in observing cultivations and seedbeds for specific crops in the range.

Alternatively, spring sown crops would equally lend themselves where it was not possible to observe all the autumn sown crops.

Outcome 2 will need to be delivered to coincide with crop growth, which will likely be all year round, especially in the case of cereals. Crop walks and visits to local arable farms can be used to cover this outcome. Tutors could ensure that the learner has access to a farm's fertiliser programme for selected crops; an introduction to a farm agronomist would also be useful, prior to the main spraying season.

Outcome 3 will probably take place in the summer before the main harvesting season. Learners should be given the opportunity to view different storage and drying systems. Where a farm centre does not have a crop storage system that covers crops in the range, then alternative arrangements should be made, such as visits to exhibitions, other farms and crop storage specialists.

Outcome 4 will need to look at previous crop history, since learners will not be in college during the summer to monitor and gather current crop harvesting, storage and marketing information. The learner will need access to farm information, current market prices, such as those in the regular farming press or on the internet.

Crop walks both in taught time and learners' own time are to be maximised. Health and safety must be regularly enforced especially with regard to machinery and chemicals.

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www.hgca.com	Home Grown Cereals Authority
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www.niab.com	National Institute of Agricultural Botany
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.wales.gov.uk	Welsh Assembly Government
www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.combineworld.co.uk	Combine World

Unit 308 Undertake Agricultural Livestock Production

Level: 3

Credit value: 10

Unit aim

This unit aims to introduce to the skills and knowledge needed for agricultural livestock production and how these can be applied in practice. This unit is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

The learner will study the range of beef, dairy, pig and sheet production systems, the principles of production animal health and breeding and practical skills and regulation involved in the planning and management of modern livestock production systems.

Learning outcomes

There are **four** learning outcomes to this unit. The learners will:

1. Understand livestock production systems
2. Know the principles of production animal health and breeding
3. Be able to perform routine livestock production skills
4. Be able to plan livestock production

Guided learning hours

It is recommended that 60 hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

Livestock Production NOS (March 2009)

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 308 Undertake Agricultural Livestock Production

Outcome 1 Understand livestock production systems

Assessment Criteria

The learner can:

1. Explain major **beef, dairy, pig and sheep production systems**
2. Evaluate **beef, dairy, pig and sheep production systems**
3. Discuss **factors** that determine the choice of a livestock production system

Unit content

Beef, dairy, pig and sheep production systems

Beef systems: grass fed, cereal fed, 18 month grass/cereal and 24 month grass/silage fed, suitability of breed and sex for production system, suckled beef production

Sheep production systems: spring lamb, lambs off grass, store lamb, breed types, environmental factors, hill, upland and lowland production

Dairy systems: housing systems, spring/autumn/year round calving patterns, heifer rearing, grazing and feeding systems, high input/high output, low input/low output, major breed types and impact on milk quality

Factors

Availability of capital for investment, housing, land quantity, topography and soil type, waste disposal systems, labour (quantity and skill levels), farming preferences (historical, skill level), proximity to and requirements of markets, transportation, supply of youngstock/stores, feed availability, current levels of profitability, impact of legislation or quotas

Unit 308 Undertake Agricultural Livestock Production

Outcome 2 Know the principles of production animal health and breeding

Assessment Criteria

The learner can:

1. Describe the **husbandry of livestock** throughout breeding/production cycles
2. Describe **routine and non-routine** livestock production service **tasks**
3. Outline **health checks** for production livestock
4. Describe **major causes of disease** and **measures to take**

Unit content

Husbandry of livestock

Feeding, grassland and grazing management, ration creation, housing preparation, requirements for heating (piglets, weaners), stocking density, application of the "five animal needs", service management, care during pregnancy and parturition, care of young, transport and movement, condition scoring

Routine and non routine tasks

Routine: examples include stock movement, weighing, use of Artificial Insemination (AI), worming, tagging, injecting, dosing, foot trimming (cattle and sheep), tail docking and teeth clipping (piglets), dagging (sheep)

Non routine: examples include medical treatment, for example for hypocalcaemia, hypomagnesaemia, mastitis, pneumonia, calving/lambing/farrowing assistance, fostering

Health checks

Assessment of feeding/grazing behaviour, checking teeth (sheep) and feet, condition scoring, weighing, observing movement, checking for lameness, growth rates, signs of alertness, coat or skin condition and appearance, udder inspection

Major causes of disease

Vectors (bacteria, virus, fungus), metabolic disorders, parasites (ecto- and endo-), life cycles, impact of hygiene, isolation and prophylactic treatment, symptoms of disease, prognosis, notifiable diseases and required actions

Measures to take

Preventative: isolation of new stock, vaccination, worming, stocking density, grassland management, husbandry care

Treatment: medicine usage, record keeping requirements, isolation, withdrawal periods

Unit 308 Undertake Agricultural Livestock Production

Outcome 3 Be able to perform routine livestock production skills

Assessment Criteria

The learner can:

1. Safely carry out **routine and non-routine** livestock production service tasks to meet given objectives
2. Perform **husbandry procedures** safely for beef and dairy cattle, sheep and pigs
3. **Safely** apply **regulations and legislation** relevant to livestock production

Unit content

Routine and non routine tasks

Routine: examples include stock movement, weighing, use of (AI), worming, tagging, injecting, dosing, foot trimming (cattle and sheep), tail docking and teeth clipping (piglets), dagging (sheep)

Non routine: examples include medical treatment, for example for hypocalcaemia, hypomagnesaemia, mastitis, pneumonia, calving/lambing/farrowing assistance, fostering

Husbandry procedures

Feeding, grassland and grazing management, ration creation, housing preparation, requirements for heating (piglets, weaners), stocking density, application of the “five animal needs”, service management, care during pregnancy and parturition, care of young, transport and movement, condition scoring

Safely

In accordance with Health and Safety at Work etc Act 1974, health and hygiene procedures, risk assessment completed, risk reduction measures in place, use of Personal Protective equipment (PPE)

Regulations and legislation

Safe use of Veterinary Medicines, use of Defra guidance and good practice, Welfare of Farmed Animals (England) Regulations 2000, application of the “five animal needs”

Unit 308 Undertake Agricultural Livestock Production

Outcome 4 Be able to plan livestock production

Assessment Criteria

The learner can:

1. **Plan production** for beef, cattle and sheep
2. Describe **requirements** for **rearing and finishing systems**
3. Plan **health programmes** for beef, dairy, pig and sheep production systems

Unit content

Plan production

Identify objectives, select systems, plan feeding and housing systems, identify target growth rates, market requirements for finished animal (meat production or store cattle/lambs), monitoring and reviewing against objectives

Requirements

Requirements for protein and energy, feed quantity, requirements for grazing/forage, requirements for trace elements and minerals, requirements at different stages of production, water requirements

Rearing and finishing systems

Production of store cattle/store lambs, meat production, suckler beef production

Beef systems: grass fed, cereal fed, 18 month grass/cereal beef and 24 month grass/silage fed, suitability of breed and sex for production system

Sheep production systems: spring lamb, lambs off grass, store lamb

Health programmes

Plan preventative health treatments (for example worming, vaccination), methods of ensuring timeliness of treatment, records (good practice, legislation), withdrawal periods, methods of monitoring effectiveness of health programme, cost/benefit analysis, reasons for a health programme

Unit 308 Undertake Agricultural Livestock Production

Notes for guidance

This unit is designed to introduce learners to the major types of agricultural livestock production in the UK, and to equip them with some practical husbandry skills. As learners will be engaged in practical activity there should be an emphasis on safe working practices, including the use of appropriate Personal Protective Equipment (PPE), and appropriate risk assessments should be undertaken. At Level 3 it is expected that learners will take an active part in completing risk assessments, so that this becomes an integral part of all practical activity. Learners should also be made aware of the importance of animal welfare, and sustainability concepts should also be demonstrated where possible.

For Outcome 1 learners need to gain an overview of the major production systems for beef and dairy cattle, sheep and pigs. It would be helpful if delivery includes visits to a number of different production systems. Where this is not feasible due to production systems not being available in the local area this should be supplemented by high quality and up to date audio visual resources.

Outcome 2 and 3 are closely linked and it is anticipated they will be delivered alongside each other. Outcome 2 focuses on learners being able to understand the major husbandry requirements of production systems, whilst outcome 3 involves learners developing the skills to undertake these husbandry tasks and requirements in practice. Learners will need supervised access to a range of production systems to enable them to practice their skills. This could be linked to appropriate work placements. It is important that health and safety of the learner and welfare of the animal are emphasised in both theory and practice. It is not anticipated that learners will develop practical skills to carry out the full range of husbandry tasks across the full range of farm animals. Delivery should be planned to enable them to gain an overview of these, but then to take part in a range of six husbandry tasks or activities for at least two categories of farm livestock (where appropriate).

Outcome 4 focuses on planning of production systems and health programmes. Learners should gain an understanding of the objectives of particular production systems and health programmes, and how planning and reviewing should be based on these objectives. Learners would benefit from visits to a range of production systems, and from guest speaker input, such as a vet or animal health official.

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Books

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www.wales.gov.uk	Welsh Assembly Government
www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.fawc.org.uk	Farm Animal Welfare Council
www.mdc.org.uk	Milk Development Council
www.mlc.org.uk	Meat and Livestock Commission

Unit 309 Understand Farm Power Units - Machinery and Operation

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of farm power units, and machinery management and operation and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

The aim of this unit is to develop learners' knowledge and understanding of cost effective management of agricultural machinery.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand the factors associated with the selection of agricultural machinery
2. Know the procurement options for agricultural machinery
3. Understand the legislation relating to agricultural machinery
4. Be able to calculate and report on the operating costs of agricultural machinery

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

C12 Prepare and operate a power vehicle

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 309 Understand Farm Power Units - Machinery and Operation

Outcome 1 Understand the factors associated with the selection of agricultural machinery

Assessment Criteria

The learner can:

1. Explain the **factors that affect selection** of a named agricultural machine
2. Assess the **performance** of a named agricultural machine

Range

Selection from a range of identified machines: land based vehicle, cultivation machine (seeding machine or combination), application machine (liquid, granule or solids), harvesting machine (grass, roots or grain)

Unit content

Factors affecting selection

Work expectations, volume of work, conditions, fitness for purpose, legislative requirements, power requirements, available operator expertise/operator training, life expectancy, availability, manufacturer/dealer support, costs, depreciation, resale value, ease of use, compatibility with power unit/other machines in system, after sales and warranty support, service contracts, direct replacement or upgrade

Performance

Work rates, range of outputs/settings, loads, quality of work, running costs, ease of use, operator comfort

Unit 309 Understand Farm Power Units - Machinery and Operation

Outcome 2 Know the procurement options for agricultural machinery

Assessment Criteria

The learner can:

1. Describe the **procurement options** available for agricultural machinery
2. Compare the options for the procurement of a named agricultural machine

Range

Selection from a range of identified machines: land based vehicle, cultivation machine (seeding machine or combination), application machine (liquid, granule or solids), harvesting machine (grass, roots or grain)

Unit content

Procurement options

Availability of finance, business/personal capital, loan from bank, finance company, manufacturer finance schemes, hire purchase, lease schemes, contract hire short seasonal/long term, trade in, retention of existing machine as back up or second unit, list prices/discount availability, new unit, pre-owned, demonstration unit, direct manufacturer purchase, dealer purchase, auctions, direct from previous owner, machinery ring

Unit 309 Understand Farm Power Units - Machinery and Operation

Outcome 3 Understand the legislation related to agricultural machinery

Assessment Criteria

The learner can:

1. Explain the **legislation** related to agricultural machinery
2. Discuss the **operator training** requirements for a selected agricultural machine

Range

Selection from a range of identified machines: land based vehicle, cultivation machine (seeding machine or combination), application machine (liquid, granule or solids), harvesting machine (grass, roots or grain)

Unit content

Legislation

Health and Safety at Work Act, 1974, Provision and Use of Work Equipment Regulations (PUWER), 1998, Food and Environmental Protection Act (FEPA) 1985, Construction and Use Regulations, Lifting Operations and Lifting Equipment Regulations (LOLER), 1998, Construction of Vehicles Regulations, taxation/insurance, Ministry of Transport Road Legality Regulations, codes of practice relating to specific land-based operations

Operator training

Dealer installation training, manufactures' operator training, training organisations, training updates, Continuous Professional Development (CPD) systems

Unit 309 Understand Farm Power Units - Machinery and Operation

Outcome 4 Be able to calculate and report on the operating costs of agricultural machinery

Assessment Criteria

The learner can:

1. Demonstrate the **depreciation costs** for a selected agricultural machine
2. Produce a report on the **annual costs** of a selected agricultural machine

Range

Selection from a range of identified machines: land based vehicle, cultivation machine (seeding machine or combination), application machine (liquid, granule or solids), harvesting machine (grass, roots or grain)

Unit content

Depreciation costs

Straight line depreciation, reducing balance depreciation, work done, regular maintenance, condition, quality of repair work, service records

Annual running costs

Depreciation, service/repair/labour, replacement parts, training costs, tax/insurance, fuel and lubricants, importance of records, negative cost, income from hire contract work

Unit 309 Understand Farm Power Units - Machinery and Operation

Notes for guidance

This unit is designed for learners who could potentially eventually have responsibilities for the management of machine/equipment fleet and will be involved with procurement and finance decisions. An understanding of operational costs, operator and machine suitability and operator training will feature in replacement/procurement decisions.

For Outcome 1, learners will need to gain an overview of the principles of selecting machinery or equipment. A useful addition to classroom delivery of the information could be visits to farms or agricultural machinery sites to see how machinery is selected by employees in the industry for real tasks and work. Classroom discussions on the suitability and performance of different types of machines for farm tasks may also be a useful method for learners to explore and expand their knowledge.

For Outcome 2, learners will need to develop an understanding of the procurement options for agricultural machinery. The classroom delivery of this outcome could benefit from discussions and presentations on the different machines by learners as well as guest speakers from companies/ organisations/ manufacturers.

For Outcome 3, learners will need to gain an understanding of the legislation and operator training requirements associated with agricultural machinery. The delivery of this outcome could benefit from talks from or visits to training organisations or agricultural machinery manufacturers to explain or demonstrate how legislation relates to the use of machinery in the workplace.

Outcome 4 focuses on the finances related to the operation of agricultural machinery. To assist with the delivery of this outcome and the learners understanding of the finances, visits to machinery manufacturers or farm sites could be beneficial. The delivery of this outcome could be linked to the delivery of Outcome 2.

Centres are encouraged to introduce employers and specific professionals from industry to provide interesting and relevant information to the learner. Teaching would also benefit from visits to a variety of establishments to add depth to the learner experience.

References

Books

Bell, B. 2005. *Farm Machinery.* (Old Pond Publishing, ISBN 1903366682

Culpin, C.1992. *Farm Machinery* 12th edition. Blackwell Scientific, ISBN 063203159X

Periodicals

Farmers' Weekly

Profi International

Unit 310 Undertake Estate Skills

Level: 3

Credit value: 10

Unit aim

This unit aims to introduce learners to the estate skills and knowledge and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or into further/higher education.

The learner will look at constructing, repairing and maintaining boundaries, structures and surfaces. They will build their experience and confidence in using practical skills in a range of situations. The learner will be able to contextualise practical management work to a particular habitat that lies within their primary area of learning.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Be able to construct, repair or maintain boundaries
2. Be able to construct, repair or maintain structures
3. Be able to construct, repair or maintain surfaces
4. Be able to carry out practical habitat management work

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

CU22.1 Construct, maintain and repair boundaries

CU20.1 Maintain structures and surfaces

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SCC

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 310 Undertake Estate Skills

Outcome 1 Be able to construct, repair or maintain boundaries

Assessment Criteria

The learner can:

1. **Prepare the site** appropriately
2. Select appropriate **equipment and materials**
3. Carry out the **construction, repair or maintenance** of selected **boundaries** to meet given specifications

Range

Boundaries

Living boundaries (hedge, bank, ditch), constructed boundaries: fence (post and rail, post and wire, electric, netting), wall (stone, brick)

Unit content

Prepare the site

Plan activity, clear debris, ensure livestock safety, location (power supply, waste disposal, equipment and materials storage)

Equipment and materials

Materials selected relevant to task, health and safety, sustainable practice, cost implications

Construction, repair or maintenance

Undertaken safely (use of risk assessment, appropriate Personal Protective Equipment (PPE)) and to the required standards

Unit 310 Undertake Estate Skills

Outcome 2 Be able to construct, repair or maintain structures

Assessment Criteria

The learner can:

1. **Prepare the structure** appropriately
2. Prepare and ready appropriate **equipment and materials**
3. Carry out the **construction, repair or maintenance** of selected **structures** to meet given specifications.

Range

Structures

Wooden structures (gate, stile, horse jump, bird box, table, bench, door), other structures requiring repair or maintenance (animal house or pen, machinery or feed store)

Unit content

Prepare the structure

Cut required sizes, wood preparation (sanding, planing, filling), check design specification, plan activity

Equipment and materials

Equipment and materials prepared based on manufacturer instructions, health and safety, sustainable practice, cost implications

Construction, repair or maintenance

Undertaken safely (use of risk assessment, appropriate Personal Protective Equipment (PPE)) and to the required standards

Unit 310 Undertake Estate Skills

Outcome 3 Be able to construct, repair or maintain surfaces

Assessment Criteria

The learner can:

1. **Prepare the surface** appropriately
2. Prepare and ready appropriate **equipment and materials**
3. Carry out the **construction, repair or maintenance** of a selected **surface** to meet given specifications.

Range

Surface

Solid (decking, concrete, paving), Loose (gravel, wood chippings, sand)

Unit content

Prepare the surface

Plan activity, clear debris, ensure livestock safety, location (power supply, waste disposal, equipment and materials storage)

Equipment and materials

Equipment and materials prepared based on manufacturer guidelines, health and safety, sustainable practice, cost implications, timeliness for example preparing concrete at the right time for construction

Construction, repair or maintenance

Undertaken safely (use of risk assessment, appropriate Personal Protective Equipment (PPE)) and to the required standards

Unit 310 Undertake Estate Skills

Outcome 4 Be able to carry out practical habitat management work

Assessment Criteria

The learner can:

1. Carry out appropriate **risk assessments**
2. Safely carry out appropriate **practical habitat management** to given specifications
3. Recommend **improvements** for future work

Unit content

Risk assessments

Risk assessments completed and used, use of Personal Protective Equipment (PPE) appropriate to the tasks (safety boots, overalls, gloves, and eye protection), and safe methods of working
Relevant legislation and codes of practice: Health and Safety at Work etc Act 1974, Control of Substances Hazardous to Health (COSHH) 2002, Waste Management (England and Wales) Regulations 2006, Construction (Design and Management) Regulations 2007

Practical habitat management

Mowing, renovation, planting and staking as applicable, clearing (path, fence line), coppicing, uprooting, hedge maintenance, pruning, thinning, cutting or mowing and mulching, pond, stream and ditch clearance
Good practice: composting, materials that can be composted, re-used and/or recycled, finding alternative uses, methods of recycling, avoid wastage
Reduce environmental damage - Pollution (water courses, through litter or debris, noise), damage to habitats, and wastage of resources
Disposal of waste: organic waste (recycling, composting, chipping, burning), inorganic waste (recycling, landfill, discarding safely)

Improvements

Setting habitat management objectives, planning activities and resources, monitoring activities and resources, reviewing outcomes against objectives, recommendations and improvements

Unit 310 Undertake Estate SkillsUnit 310 Undertake Estate SkillsUnit 310 Undertake Estate Skills

Notes for guidance

This unit has a very practical focus, and aims to enable learners to develop estate skills which can be applied to a range of situations and circumstances. The unit has been written such that naturally occurring and locally relevant opportunities can be used in selecting sites, structures and surfaces to construct, repair or maintain.

As learners will be engaged in practical activity there should be an emphasis on safe working practices, including the use of appropriate personal protective equipment (PPE), and appropriate risk assessments should be undertaken. At Level 3 it is expected that learners will take an active part in completing risk assessments, so that this becomes an integral part of all practical activity. Learners should also be made aware of the impact on the environment, and sustainability concepts should also be demonstrated where possible.

Learners should have the opportunity to undertake estate skills activity in a land-based setting wherever possible to maximise the vocational relevance. It will be most beneficial if the structures, boundaries and surface selected are for a clear purpose above and beyond delivery of this unit. It is recognised that there will not be opportunities to carry out construction, repair *and* maintenance in each of the categories, but it would be appropriate for the skills of construction, repair and maintenance to each be developed in one aspect of the unit.

In Outcome 1, learners will develop the practical skills needed to construct, repair or maintain at least two different boundaries, including a living boundary and a constructed one.

In Outcome 2, learners will construct, repair or maintain at least two different structures. It is anticipated that learners will develop an understanding of how to construct a wooden structure, but are not expected to be able to construct larger structures such as animal or machinery housing. It is anticipated that delivery will include repair and maintenance of such larger structures as would be found in an estate setting.

In Outcome 3, learners are required to construct, repair or maintain one surface from the range shown. Delivery may include visits to see a range of surfaces and their properties and maintenance requirements.

In Outcome 4 it is anticipated that delivery of this outcome will be embedded in the practical skills development within the other three outcomes. These outcomes could also be developed in conjunction with learners' work experience at an appropriate placement.

It is anticipated that most delivery of this unit will take place in a practical setting, with supervised practice of skills. Delivery will also include some classroom based activity in ensuring learners have a good understanding of planning, materials selection and preparation, and underpinning knowledge.

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Unit 311 Understanding Principles of Land-based Machinery

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of land-based machinery and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

The aim of this unit is to provide learners with skills, knowledge and understanding to enable them to select, evaluate, maintain and repair a range of land-based machines typical to their area of study.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know the function of key components found in land- based machines and power units
2. Understand operating principles of land-based machines and power units
3. Be able to undertake routine maintenance of land-based machines and power units
4. Understand the applications of land-based machines and power units

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

CU28 Prepare for and maintain equipment and machines

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- A range of assignments covering practical skills and underpinning knowledge.

Unit 311 Understanding Principles of Land-based Machinery

Outcome 1 Know the function of key components found in land-based machines and power units

Assessment Criteria

The learner can:

1. Identify **key components** used in land-based machines and power units
2. State the purpose of the **key components** of selected land-based machines and power units
3. Describe **operator adjustments** and **control systems** on selected land-based machines and power units

Unit content

Key components

Power units: engine components, lubrication and cooling systems, air supply and filtration, electrical systems
Mechanical power transmissions: gears, shafts, belts and pulleys, chains and sprockets, bearings, bushes, clutches, safety overload protection systems, power take off components and systems
Hydraulic systems: reservoirs, pumps, motors, filters, control valves and systems, oil cooling, pipes and fittings, pressure relief valves, pressure accumulators
Electrical systems: battery, fuses, generators, sensors, lighting, motors, cables and connections, auxiliary supply

Operator adjustments

Power unit: speed, power, economy
Mechanical power transmission: powers take off speeds and alignment, gear selection, belt and chain tensioning, clutch adjustment, overload protection adjustment
Hydraulic system: pressure and flow control, position, draft and mixture control, auxiliary connections and services, single and double acting supply, closed and open centre systems, mechanical and electrical control systems, pressure accumulation
Electrical systems: alternating and direct current, sensors, switches rheostats

Control systems

Operator ergonomics, position of controls, wheels, tracks, skids and flotation, steering systems, braking systems, differential locking, manual selection, automatic integration headland management, global positioning

Unit 311 Understanding Principles of Land-based Machinery

Outcome 2 Understand operating principles of land-based machines and power units

Assessment Criteria

The learner can:

1. Explain the operating principles of selected land-based machine **power unit** and **power transmission systems**
2. Compare the operating principles of the following systems to be found on land-based machines and power units
   - **2 stroke and 4 stroke power units**
   - AC and DC **electrical systems**
   - Closed and open centre **hydraulic systems**
3. **Describe the operating principles and service requirements for a** liquid cooling system **and** air filtration system **to be found on a land-based machine power unit**

Unit content

Power units

Engine rpm, fuel types, weight, fuel consumption, power torque, exhaust emissions

Power transmission systems

Vehicle transmissions, lines of drive, reduction gearbox, interchangeable sprockets and pulleys, variator drives slip clutch, chatter clutch, shear bolts

2 and 4 stroke engines

2 stroke cycle, four stroke cycle, fuel system, lubrication system (pressure lubrication, splash feed), turbo chargers

Electrical systems

Alternating current, direct current, voltage and current flow, simple circuits, fuse ratings, applications to land-based vehicles and hand operated electrical powered equipment, charging and generating system, solenoids , actuators

Hydraulic systems

Hydraulic circuits, reservoirs, pumps, motors, open and closed systems, oil cooler, flow and return filtration

Liquid cooling systems

Liquid and air-cooled systems, fans, pumps, thermostat, coolant, pressure caps, airflow, cowlings, guards

Air filtration systems

Pre-cleaners, cyclones, oil bath, filters, restriction warning system, unloader valves

Unit 311 Understanding Principles of Land-based Machinery

Outcome 3 Be able to undertake routine maintenance of land based machines and power units

Assessment Criteria

The learner can:

1. Carry out **risk assessments** in preparation for performing **routine maintenance** tasks on selected land-based machines and power units
2. Carry out routine maintenance, according to **manufacturers' recommendations** to a selected land-based machine
3. Complete **documentation to record maintenance tasks** carried out on a selected land-based machine

Unit content

Risk assessments

Health and safety and environmental protection, hazards, risks, control measures, safe use of tools, jacks, lifting equipment, power isolation, Health and Safety at Work etc Act 1974 (HASWA), Control of Substances Hazardous to Health (2002) (COSHH), Provision and Use of Work Equipment Regulations 1998 (PUWER), Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)

Routine maintenance

Pre-start checks, pre operation inspections, routine maintenance, recommended service procedures, correct use of service charts, operator manuals, lubricant data sheets

Manufacturers' recommendations

Time intervals, work intervals, recommended lubricants, correct filters, service procedure, adjustments, critical settings, warranty restrictions

Documentation to record maintenance tasks

Check list, job card, date of service, type of service, replacement components used , vehicle recognition, serial and registration numbers, future service due indication on machine

Unit 311 Understanding Principles of Land-based Machinery

Outcome 4 Understand the applications of land-based machines and power units

Assessment Criteria

The learner can:

1. Explain the **applications** of the **power unit**, **transmission** and **hydraulic system** on a selected land based machine
2. Discuss **operator settings** available on **power unit**, **transmission** and **hydraulic systems** when operating a land-based machine
3. Assess the effects on the **performance** of given land-based machines when changing operator settings on
   - **Power unit**
   - **Transmission system**
   - **Hydraulic system**
4. Evaluate **alternative designs** of the following systems adopted by different manufacturers
   - **Power unit,**
   - **Transmission system**
   - **Hydraulic system**

Unit content

Applications of the

Power unit: power, torque, fuel consumption, mobile and fixed applications, vehicles, generators
Transmissions: speed, ratios, torque requirements, traction
Hydraulic system: linkage, brakes, steering, power transmission operation, external supply

Operator settings

Power unit: speed (rpm)
Transmission: gear selection
Hydraulic system: position, draft, mixed and external services

Performance

Power unit: power, torque, fuel consumption, exhaust emissions
Transmission: traction, speed, travel direction, power take off speed
Hydraulic system: system pressure, flow rate, capacity, external services flow rate, motor speeds

Alternative designs

Power unit: cylinder number and configuration, turbocharged, capacity, spark ignition systems, type of fuel system/management

Transmission system: constant mesh, synchromesh, powershift, constantly variable transmissions, mechanical transmission clutch, fluid drive clutch, power drive clutch operation

Hydraulic system: open centred, closed centred, mechanical control, electro-hydraulic control, single/double acting external spool valves, fluid flow control

Unit 311 Understanding Principles of Land-based Machinery

Notes for guidance

This unit is designed to provide learners with knowledge and understanding of the working principles of a range of land-based power units and equipment to be found in their area of study. It will also allow learners the opportunity to carry out routine maintenance tasks to manufacturers' recommendations and specifications. At all times when practical tasks are carried out or assessed, an emphasis must be put on safe working practices and current legislations.

The range of machinery covered should include electric vehicles and machines if appropriate.

In Outcome 1, the learner will be required to investigate working principles of the range of engine types that power land based vehicles and machines. It is essential that the learner understands the limitations of engine types and why manufacturers designate their use to different purposes. The learners should be encouraged to develop understanding of topical issues regarding available fuel types, environmental pollution and running costs.

Outcome 2 prepares the learner for the knowledge and understanding required prior to undertaking practical maintenance work on engines and powered machines.
Emphasis should be directed to safe working practices, care of machines, tools and work areas. The learner should also be encouraged to develop forward thinking for the need for basic tool requirements which may be required on the work site where unscheduled maintenance tasks may have to be performed, hence the need for basic tools to be available on the vehicle or machine. Due to the complexity of modern vehicles and machines it is essential that learners understand that maintenance of machines and vehicles must be carried out to manufacturers recommendations and service documentation should be available and accurately followed when performing tasks.

In Outcome 3, the learner will be required to assess all risks to themselves, others, the environment and equipment prior to commencing practical tasks.
These risks should be recorded for future reference and appropriate control measures put in place and recorded against the risk.

The learner must be aware of current legislations and safe working practices and be encouraged to adopt a clean, tidy and methodical approach to work ethic and must be aware of consequences for his actions should the work carried out be responsible for injury or damage to a third party. The importance of completion of maintenance and work records must be highlighted as should the need for retrieval of those records from file for future reference particularly when assessing warranty claims, recurring failures or valuation on replacement.

Throughout the unit the emphasis will be on safe, legal practices, working to manufacturers' recommended procedures and attention to detail when recording information.

Depending on the land-based area the learner is studying, formal lecture delivery may be generic to all areas but practical experiences and learning should be appropriate to the area of study.

In Outcome 4, the learner will be able to explain how power unit speed can affect performance and efficiencies and explain how different engine types have different performance characteristics.
The learner will be able to demonstrate understanding of how power produced from the power unit can be distributed to a transmission system and hydraulic system to provide drives to propel a machine, provide mechanical and hydraulic drive to allow land-based machines to function.

The learner should be able to describe methods by which transmission settings can be used to control travel speeds and direction and by which hydraulic fluid speed and pressure settings affect performance of hydraulically driven and adjusted machines and equipment.

This Outcome requires learners to be able to compare a range of power units and machines from different manufacturers to evaluate alternative designs and systems that produce similar outcomes. It will, therefore, be necessary for learners to have access to a range of modern equipment for these comparisons and evaluations to be made.

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www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.hse.gov.uk	Health and Safety Executive

Unit 312 Understand Agricultural Forage Crop Production

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of agricultural forage crop production and how these can be applied in practice. It is designed for learners in a centre-based settings looking to progress into the sector or onto further/higher education.

The aim of this unit is to develop the learners' practical skills and understanding of the benefits of a range of non-grass forage crops

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know the role of a range of forage crops
2. Be able to plan the growth of forage crops
3. Understand the methods of harvesting and storing forage crops
4. Understand the benefits and production costs of forage crops

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

AgC9 Prepare, monitor and cultivate sites for planting crops
AgC10 Promote, monitor and maintain the healthy growth of extensive crops
AgC11 Prepare planting equipment and plant extensive crops
AgC12 Control the harvesting of extensive crops by mechanical means

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 312 Understand Agricultural Forage Crop Production

Outcome 1 Know the role of a range of forage crops

Assessment Criteria

The learner can:

1. Identify different **forage crops** at different growth stages
2. Describe the **botanic and agronomic characteristics** of forage crops
3. Outline the **value of forage crops** for different classes of livestock

Range

Maize, roots (e.g. stubble turnips, fodder beet), brassicas (e.g. kale, forage rape), whole crop, forage rye, legumes (e.g. peas, beans, lucerne, clover)

Unit content

Forage crops

Field identification (from seedlings to mature crop), identify seeds

Botanic and agronomic characteristics

Classification of species, growth patterns, time of year when used

Value of forage crops

Extending /replacing grazing, role as a catch /break crop, contribution to a ration (for example animal growth rates and finishing, variety in ration, expected Dry Matter Intakes (DMI) and Metabolisable Energy (ME), palatability and suitability to stock

Unit 312 Understand Agricultural Forage Crop Production

Outcome 2 Be able to plan the growth of forage crops

Assessment Criteria

The learner can:

1. Contribute to the **preparation of soil** for forage crops
2. Plan a **fertiliser programme** for forage crops
3. Describe **weed, pest and disease control** procedures appropriate to production of a named crop
4. Follow correct **legislative and environmental guidelines**

Range

Maize, roots (e.g. stubble turnips, fodder beet), brassicas (e.g. kale, forage rape), whole crop, forage rye, legumes (e.g. peas, beans, lucerne, clover)

Unit content

Preparation of soil

Soil type suitable for crop, drainage and topography, select appropriate machinery, seedbed requirements, timing of cultivations and drilling

Fertiliser programme

Requirements for major and minor elements, previous crop residual values, pH requirements, use of organic manures and timing (e.g. match Nitrogen Vulnerable Zone (NVZ) guidelines)

Weed, pest and disease control

Weed control: mechanical (e.g. topping, harrowing, stale seedbed), chemical (e.g. pre-emergent, selective)

Pest control: aphids and virus spread, pigeons, slugs and traps, use of treated seeds

Disease control: identify fungal diseases (e.g. mildew)

Legislative and environmental guidelines

Environmental Protection Act 1990, Cross Compliance Nitrates Directive 1991, Water Framework Directive 2003, Local Environment Risk Assessment Procedures (LERAP's), UK pesticide guide, Nitrate Vulnerable Zones (NVZ's), timing of applications, Entry Level scheme rules, Defra good practice guidance, for example Protecting our Water, Soil and Air: A Code of Good Practice for farmers, growers and managers (the 'CoGAP').

Unit 312 Understand Agricultural Forage Crop Production

Outcome 3 Understand the methods of harvesting and storing forage crops

Assessment Criteria

The learner can:

1. Explain **harvesting arrangements** for forage crops
2. Evaluate suitable **storage methods** for forage crops.

Range

Maize, roots (e.g. stubble turnips, fodder beet), brassicas (e.g. kale, forage rape), whole crop, forage rye, legumes (e.g. peas, beans, lucerne, clover)

Unit content

Harvesting arrangements

Timing (e.g. weather, seasonality), crop maturity
Harvest by stock: strip grazing and electric fencing, amounts per day, use of run-back field to prevent crop and field poaching, length of harvesting period relative to following crop
Harvest by machine: types of machinery, trailers, health and safety

Storage methods

Preparation of store, methods of storage (e.g. clamp) monitoring of crop in store e.g. silage analysis and interpretation, heating up in clamp and frost protection for fodder beet, minimising storage losses

Unit 312 Understand Agricultural Forage Crop Production

Outcome 4 Understand the benefits and production costs of forage crops

Assessment Criteria

The learner can:

1. Analyse **crop yields**
2. Assess the **nutritional value** of forage crops for different classes of livestock
3. Compare **production costs** of different forage crops

Range

Maize, roots (e.g. stubble turnips, fodder beet), brassicas (e.g. kale, forage rape), whole crop, forage rye, legumes (e.g. peas, beans, lucerne, clover)

Unit content

Crop yields

Target yields, field estimates both pre-harvest and being harvested by stock, predicted animal intakes to match moving electric fence, prediction of likely end of harvest by stock to match following crop needs

Nutritional value

Crop value to match the animal ration (e.g. Dry Matter, ME and protein value), animal intakes and any associated disease problems (e.g. bloat in clovers), contribution to animal growth rates and live weight gain

Production costs

Comparison of actual costs with published data, gross margin calculations, manurial values to soil and following crop, unit cost ME, labour costs, contractor's charges

Unit 312 Understand Agricultural Forage Crop Production

Notes for guidance

This unit deals with the role of forage crops within an arable cropping programme. Care will be needed by the tutor not only to ensure that the range of crops is covered, but also to be flexible in accounting for local growing conditions. For example, forage maize may not be suitable in all upland areas, so tutors need to be mindful of any events, local farms that can be used for visits.

Some crops will be grazed in situ by livestock (e.g. lambs on stubble turnips, cows on kale and so fairly seasonal; others will be used in yards (e.g. fodder beet to beef cattle, maize silage to dairy and beef cattle) and so tutors will need to link them with livestock feeding.
Because of the nature of the seasonality of the crop and its use, tutors will need to plan the programme carefully.

Outcome 1 needs to be delivered first, so that students can recognise the crops they are dealing with. It would lend itself to classroom, laboratory and field studies, such as crop walking. The use of a power point presentation to cover the range of crops might be useful.

In Outcome 2, tutors needs to be aware that some forage crop establishment programmes are likely to have taken place before students start a course (e.g. stubble turnips). Autumn crop walks early on into the programme will be needed. Some crops will be established in spring (e.g. maize, beet) so this outcome may have a degree of flexibility in respect of its timing. Many fields, however, are likely to receive manure applications during the autumn /winter (e.g. for maize), so student involvement with machinery could be planned in liaising with a farm.

Harvesting will vary according to locality and crop type in Outcome 3. Fodder beet and maize are machinery based and could involve students on trailers from field to clamp. Stubble turnips and kale will be largely strip grazed. Tutors must ensure that students experience both types of harvesting wherever possible. Where clamps are used (e.g. maize) students need to be shown a silage analysis and its interpretation.

Outcome 4 is largely class based and might form a useful case study approach, whether individual or as a team exercise. It will probably be taught as the last outcome and so more likely in the summer term.

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www.dardni.gov.uk	Department of Agriculture and Rural Affairs(Northern Ireland)

Unit 313 Understand Agricultural Organic Production

Level: 3

Credit value: 10

Unit aim

This unit aims to introduce learners to the skills and knowledge needed for agricultural organic production, and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.
The learner will develop their understanding of organic production principles and practices. They will consider how organic practices affect the health of soil, crops, animals and the environment and apply organic methods with a crop context.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will:
1. Know the development of organic farming practices
2. Understand how to manage soil using organic principles
3. Be able to apply organic methods to crop production
4. Know how to apply organic methods to livestock production

Guided learning hours
It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards (if appropriate, otherwise omit)
AgC9 Prepare, monitor and cultivate sites for planting crops
AgC10 Promote, monitor and maintain the healthy growth of extensive crops
AgC11 Prepare planting equipment and plant extensive crops
AgC12 Control the harvesting of extensive crops by mechanical means

Endorsement of the unit by a sector or other appropriate body (if required, otherwise omit)
This unit is endorsed by Lantra SCC.

Assessment and grading
This unit will be assessed by:
- An assignment covering practical skills and underpinning knowledge.

Unit 313 Understand Agricultural Organic Production

Outcome 1 Know the development of organic farming practices

Assessment Criteria

The learner can:

1. Describe the **development of organic farming practices** in the UK
2. List the **main national and international organic organisations**

Unit content

Development of organic farming practices

Historical perspectives: principles of sustainability, role of national and international organisations, development of organic standards, role of government departments (including regulation of organic practices), conversion process, maintaining resources and biodiversity, bio security

Main national and international organic organisations

International Federation of Organic Agriculture Movements (IFOAM), Soil Association, Organic Farmers and Growers, Organic Advisory Service, research institutions

Unit 313 Understand Agricultural Organic Production

Outcome 2 Understand how to manage soil using organic principles

Assessment Criteria

The learner can:

1. Explain the **factors that are important in maintaining healthy soil** in an organic context
2. Illustrate **factors that increase fertility** of soil

Unit content

Factors that are important in maintaining healthy soil

Soil degradation: soil erosion, leaching, depletion of natural nutrients

Conversion process: transition to organic production for example non-organic pesticide and artificial fertiliser residues, planning

Factors that increase fertility

Fertility building and maintenance (rotations, natural soil fertility, biological nitrogen fixation), sources of organic matter (livestock manures, composts), soil health (microbial activity, biodiversity), organic soils management plan

Unit 313 Understand Agricutural Organic Production

Outcome 3 Be able to apply organic methods to crop production

Assessment Criteria

The learner can:

1. Plan **soil management** using organic principles
2. Prepare a **crop rotation** that applies organic methods to a selected site

Unit content

Soil management

Soil conditions, cultivations and sowing practices, crop diversity, weed control, effect on crop quality, fertility building- use of green manures, organic fertilisers

Crop rotation

Historical perspectives, maintenance of soil quality, avoidance of pest and disease build-up, reduction of weed problems, diversity, fertility building, stockless systems, nitrate leaching

Unit 313 Understand Agricultural Organic Production

Outcome 4 Know how to apply organic methods to livestock production

Assessment Criteria

The learner can:

1. Describe **how animals are managed** in organic production systems
2. Identify **suitable sources of feed** for selected organic livestock.

Unit content

How animals are managed

Role of livestock on an organic farm, animal welfare, current relevant codes of practice, preventative health care, role of conventional medicine and restrictions on use, alternative strategies, clean grazing systems, housing, role of animals and manures in rotation, health and safety

Suitable sources of feed

Feeds and feeding, integration of livestock and cropping systems, grazing and fodder crops, out sourced feeds, closed system production

Unit 313 Understand Agricultural Organic Production

Notes for guidance

This unit introduces the learner to the principles and practice of organic production in the UK. It allows the learner to review and understand the guiding principles that form the basis of organic farming and explains the practices that farmers adopt to adhere to these principles. The description 'organic' is used generically in the context of this unit, so complementary philosophies such as biodynamic agriculture can be considered.

Throughout this unit the leaner should reflect on how organic practices affect the health of soils, crops, animals, the environment and the wider countryside community. This unit will show the relationship of different enterprises within an organic system.

Outcome 1 looks at the principles that underpin organic farming practices. The process of conversion will be explored and the roles of regulatory and advisory organisations investigated. This outcome will need to be delivered in a historical perspective, describing the development of organic principles and the individuals and organisations that developed them. Learners will study the methods and associated activities commonly used in organic farming in the UK. Organic agriculture should be investigated in a local and national context.

Outcome 2 will develop an understanding of the importance of maintaining healthy soils as the basis of organic production. In the delivery of this outcome learners will need to examine issues of soil degradation and the methods used to restore and maintain soil fertility.

Outcomes 3 and 4 will enable the learner to examine and apply the application of organic principles to crop and livestock production. Learners will look at the methods that organic producers use to maintain production whilst controlling weeds, pests and diseases of crop and livestock enterprises.

In Outcome 4 the learner must understand the importance of animal welfare.

Health and safety and bio-security issues relating to working on, or visiting organic farms must be emphasised to the learner throughout and regularly reinforced. Appropriate risk assessments must be carried out prior to practical activities and suitable personal protective clothing Personal Protective Equipment (PPE) worn as necessary.

This unit should be delivered using a variety of method such as classroom based sessions, investigative projects, group work, site visits and practical exercises. Centres are encouraged to use employers and specific professionals from industry as guest speakers to provide current and relevant information to the learners. Delivery would also benefit from visits to a variety of establishment to add depth to the learner experience.

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www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.wales.gov.uk	Welsh Assembly Government
www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.organicfarmers.uk.com	Organic Framers and Growers
www.sac.ac.uk	Scottish Agricultural College
www.soilassociation.org	Soil Association

Unit 314 Understand and Promote Animal Health

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of animal health and how these can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

The learner will be able to recognise the signs of good and ill health in animals and evaluate these as indictors of health status. The learner will carry out health checks on animals and produce animal health plans. The structure and role of pathogenic organisms will be examined and prevention and treatment of a range of diseases and disorders covered. The learner will be able to carry out routine and non-routine treatments for animals.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

5. Be able to recognise indicators of health in animals
6. Understand common disease and disorders, their treatment and prevention
7. Be able to promote and maintain the health and wellbeing of animals
8. Know how to deliver and record basic animal treatments

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

AC10.1 Implement plans to maintain animal health and welfare

AC10.2 Monitor and evaluate the maintenance of animal health and welfare

AC14.1 Provide information on how to maintain the behaviour, health and welfare of animals

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 314 Understand and Promote Animal Health

Outcome 1 Be able to recognise indicators of health in animals

Assessment Criteria

The learner can:

4. Describe the **indicators** of good and ill health in animals
5. Carry out **health checks** on animals
6. **Handle animals** in a way that complies with **legislation**, **minimises stress and injury**

Range

Animal Management – companion (dog or cat) and either small mammals (rabbit and rodents) or exotics or large mammals (goat, camelids, donkey, pig or other available large mammals)

Unit content

Indicators

Physical signs e.g. behaviour, movement, posture, coat condition, weight, ears eyes mouth and nose, tail, toes/feet/hooves (as appropriate) clinical signs e.g. temperature, pulse, respiration

Health checks

Routine, non-routine, animals of different life stages (young, breeding/pregnant, lactating, adult, geriatric), recording requirements, reporting requirements, acting on findings of ill health or problems

Handle animals

Reasons and techniques for handling - grooming, health checking, transportation, sexing, administration of treatments, handle animals of different ages, sizes and temperaments

Legislation

Animal Welfare Act 2006 and Animal Health and Welfare Act (Scotland) 2006, Health and Safety Act 1974, Welfare of Animals (Transport) Order 2006, Control of Substances Hazardous to Health (COSHH) 2002, The Welfare of Animals at Market Order 1990 (as amended 1993), The Welfare of Farmed Animals Regulations 2000 (as amended 2003), The Veterinary Surgeons Act 1966 (as amended 1996), The Welfare of Animals Regulations (slaughter or killing) 1995 (England) (amended 2007), Horse Passports Regulations (England) 2004, Pet Travel Scheme (PETS)

Minimising stress and injury

Safe and correct handling techniques, handling and restraint equipment (as appropriate to the species) pet carriers, collars, halters, headcollars, bridles, leads, muzzles, crates, catchpole, cattle crush, chases/runs, gates, tethers, snake hooks, snake bags, gloves and bird bag

Unit 314 Understand and Promote Animal Health

Outcome 2 Understand common disease and disorders, their treatment and prevention

Assessment Criteria

The learner can:

4. Examine the **role of pathogenic organisms** in animal disease and the **immune system**
5. Explain **common diseases and disorders** in animals and their impact on health and welfare including **notifiable** and **zoonotic**
6. Explain the reasons and methods of **preventative care** and treatment measures used for animals

Range

Animal Management – companion (dog or cat) and either small mammals (rabbit and rodents) or exotics or large mammals (goat, camelids, donkey, pig or other available large mammals)

Unit Content

Role of pathogenic organisms and the immune system

Bacteria, viruses, fungi, prions, protozoa, ecto and endo parasites, the methods of disease transmission, infection, the immune response, immunity (passive, natural, active and artificial)

Common diseases and disorders

Principle causes (bacterial, viral, fungal and parasitic) routes of transmission – and signs of commonly found diseases and disorders in the range of species

Notifiable diseases

A notifiable disease is a disease named in section 88 of the Animal Health Act 1981 or an Order made under that Act. Section 15(1) of the Act – cover diseases appropriate to animals from the range

Zoonotic diseases

Diseases and infections which are naturally transmitted between vertebrate animals and man – cover diseases appropriate to animals from the range

Preventative care

Vaccinations, endo-parasite prevention, ecto-parasite prevention, care of teeth, claws/hooves and coat, use of prophylactics, isolation and quarantine

Unit 314 Understand and Promote Animal Health

Outcome 3 Be able to promote and maintain the health and wellbeing of animals

Assessment Criteria

The learner can:

3. Develop **plans** to promote and maintain animal health and wellbeing throughout the year
4. Implement measures to **promote** and maintain **the health and wellbeing of animals**
5. **Monitor and report** on animal health and wellbeing

Range

Animal Management – companion (dog or cat) and either small mammals (rabbit and rodents) or exotics or large mammals (goat, camelids, donkey, pig or other available large mammals)

Unit content

Plans

Animal health management plans are to record individual details, day/time, and include the following assessments: behavioural, physical and clinical with records on diet and faeces, breeding and weight. Weekly, yearly and seasonal plans with recorded measures taken to maintain and promote health

Promote the health and wellbeing of animals

Five animal needs, animal health care routines with minimum guidelines as set out by Department for Environment, Food and Rural Affairs (Defra) (England), Welsh Assembly Government (Wales), Scottish Executive Environment and Rural Affairs Department (SEERAD) (Scotland), or Department of Agriculture and Rural Affairs (DARD) (Northern Ireland), or individual animal advisory bodies

Monitor and report

Monitor animal health and management plans, record keeping, and reporting procedures for disease control

Unit 314 Understand and Promote Animal Health

Outcome 4 Know how to deliver and record basic animal treatments

Assessment Criteria

The learner can:

3. Describe how to deliver a range of **basic routine** and **non-routine animal treatments** safely in line with codes of practice and legislation
4. Describe the importance of **monitoring animals** after treatment
5. Describe the methods for monitoring animals and the **records** required

Range

Animal Management – companion (dog or cat) and either small mammals (rabbit and rodents) or exotics or large mammals (goat, camelids, donkey, pig or other available large mammals)

Unit content

Basic routine treatments

Endo parasite prevention, ecto parasite prevention, care of teeth, claws/hooves, routes of administration (topical, enteral, and parenteral). Frequency of treatment, timing, sourcing treatments e.g. where to purchase, assessing animal for adverse reactions, limitations of treatment (effectiveness) and limitations of person providing treatment (Vet Surgeons Act 1966 and Veterinary Medicines Regulations 2009)

Non-routine animal treatments

Accidents and injuries: Shock, Road Traffic Accident (RTA), hypothermia, hyperthermia, convulsions, fractures, eye and ear wounds, hoof, paw or claw wounds, choking, poisoning, abscesses, burns and scalds, bites and stings

Bandaging techniques, cleaning and dressing wounds, administering first aid and medication, sick nursing, consideration of working with an unpredictable animal and precautions to take

Monitoring animals

Observation of physical signs and behaviour, frequency of monitoring, expected recovery times/rates, knowing when to seek assistance from the vet or supervisor.

Records

Veterinary records, feeding and water intake records, monitoring of clinical signs against expected recovery, frequency of defecation and urination

Unit 314 Understand and Promote Animal Health

Notes for guidance

This unit is designed to provide the learner with sound knowledge and skills required to promote and maintain health in animals. Depending upon which qualification this unit is delivered through, the context of teaching will differ. The unit should cover a range of species as appropriate to the area of study:

Animal Management – companion (dog or cat) and either small mammals (rabbit and rodents) or exotics or large mammals (goat, camelids, donkey, pig or other available large mammals)

Throughout the unit, the emphasis should be on safe working. It is expected that learners will be aware of safe working practices and familiar with accepted practices and behaviours within the context in which they are working. Emphasis needs to be placed on the duty of care of learners to the animals with which they are working, and at no time should any of the activities have a negative impact upon animal welfare, as far as is possible.

In Outcome 1, the learner will be required to recognise signs of both good and ill health in animals. It is accepted that this outcome will require some formal delivery but it should also be delivered in practical situations where learners are visually assessing animals for health and undertaking health checks. Learners should be encouraged to handle a range of animals, with the emphasis on safe working and dealing with animals in a way which reduces stress and minimises injury to the learner, animals and others.

Outcome 2 covers a wide range of diseases and disorders that affect animals. It is anticipated that the delivery of this unit will be through formal lectures, but it would be beneficial to include learning within the wider context of animal health. For example, reference and links to control of diseases within EU Government guidelines (e.g. Department for Environment, Food and Rural Affairs (Defra) (England), Welsh Assembly Government (Wales), Scottish Executive Environment and Rural Affairs Department (SEERAD) (Scotland), or Department of Agriculture and Rural Affairs (DARD) (Northern Ireland)) and internationally could be explored. Current and topical issues regarding animal health should be highlighted.

In Outcome 3, the learner will be required to develop plans to promote and maintain the wellbeing of animals. The emphasis should be on improving animal health and welfare underpinned by knowledge on disease prevention and control (bio security). Health plans should evolve throughout the year, identifying the current situation, health and welfare targets within given time frames and allow for reassessments over time. Reference should be made to wider national strategies for health planning and management.

In Outcome 4, the learner will be able to deliver and record basic treatments to animals. Candidates should be allowed the opportunity to cover different types of treatments, including routine, such as those for internal and external parasites and non-routine, such as dealing with accidents and injuries.

Learners working towards level 3 are likely to have experience of animal health and welfare. This unit aims to extend the learners knowledge and skills involved with ensuring the health and welfare of animals. Emphasis should be placed not only on 'doing', but also upon the importance of planning and strategies to promote health and welfare for animals nationally in accordance with government regulations and not only for those situations within their charge. It is important that the learner understands current legislation and Codes of Practice in relation to animal health and welfare.

Centres are encouraged to introduce employers and specific professionals from industry to provide interesting and relevant information to the learner. Teaching would also benefit from visits to a variety of establishments to add depth to the learner experience.

It is accepted that formal lectures will be necessary at level 3 but for this unit it is recommended that they are they are linked directly with interactive lessons in a real environment. Learners must be given the opportunity to deal with a range of animals in different situations which reflects current industry practice.

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Unit 315 Understand Grassland Management

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of grassland management and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

This unit enable learners to develop the knowledge and skills needed to successfully manage grassland. It can be applied to all grazing livestock enterprises and grass kept for conservation purposes.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand grasses and grass growth.
2. Understand the factors to consider when establishing and maintaining grass
3. Be able to manage grassland for grazing
4. Know how to conserve grass

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

Agc4 Prepare and cultivates sites for planting extensive crops
Agc5 Prepare for planting and plant extensive crops
Agc6 monitor and maintain the healthy growth of extensive crops
Agc7 Preparation and harvesting of crops by mechanical means
Agc8 Store harvested crops

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 315 Understand Grassland Management

Outcome 1 Understand grasses and grass growth.

Assessment Criteria

The learner can:

1. Explain the **terminology** used in grass production and management
2. Relate **growth patterns** to the management of grass for grazing and conservation
3. Discuss the **agronomic characteristics of key grass species/varieties**
4. Discuss the **agronomic characteristics of common weed grass species**

Unit content

Terminology

Types of grassland: hill grazing, permanent pasture, leys (plants making up the sward), physiology of the grass plant (vegetative and inflorescence), digestibility of grass, how it is measured and factors which influence this

Growth patterns

Establishment of grass (grassland production curve, seeds mixtures), managing grass for grazing (hay and silage), effect of soil type, fertiliser, climate and topography on grassland production

Agronomic characteristics of key grass species/varieties

Grass identification and assessment: recognise productive grassland species such as Italian rye grass, perennial rye grass, Timothy, Cocksfoot, meadow fescue, white and red clover and some herbs. Identify attributes that make these species desirable

Agronomic characteristics of common weed grass species

What makes a grass a weed, grass weeds (annual meadow grass, chickweed, yorkshire fog, brome), use of grass keys to identify weed grass species, environmental considerations

Unit 315 Understand Grassland Management

Outcome 2 Understand the factors to consider when establishing and maintaining grass

Assessment Criteria

The learner can:

1. Compare the alternative **methods used to prepare a site for and establish a grass crop**
2. Assess **nutrient requirements** for grassland and prepare a nutrient programme to meet production and sward needs
3. Describe **how common weeds, pests and diseases of grass can be controlled**
4. Discuss the **factors that contribute to sward deterioration**

Unit content

Methods to prepare a site and establish grass crop

Soil type, drainage and topography, reseeding techniques, plough and reseed (Autumn and Spring), under-sowing, direct drilling, renovation, partial and full

Nutrient requirements:

Grass crop requirements, Dry Matter production targets, grassland pH targets, the role of Nitrogen, Phosphate, Potash and Minor elements, Nitrogen-Potash relationships, Environmental considerations including Nitrate Vulnerable Zone (NVZ) calculations

How weeds, pests and diseases of grass can be controlled

Weed control: mechanical (topping, rolling), chemical (complete sward destruction, selective weed killers, weed wipers), manual weeding
Pest Control: moles, rabbits, deer, badgers and their effect on grassland, legislation and health and safety issues
Diseases control: common endoparasites with lifecycles for each, control measures and economic impact of neglect, rotational grazing; crop rotation, use of conservation crops to break disease cycles

Factors that contribute to sward deterioration

Grazing Pressure (high and low), drainage, poor fencing, soil type and poaching, age of sward, timeliness of machinery operations

Unit 315 Understand Grassland Management

Outcome 3 Be able to manage grassland for grazing

Assessment Criteria

The learner can:

1. Carry out **soil sampling and analysis**
2. **Monitor grass** during the grazing season
3. Carry out **grassland improvement activities**.

Unit content

Soil sampling and analysis

Set effective nutrient levels for pH and the major grassland nutrients, take statistically valid soil samples and make field scale determination of pH, P and K levels

Monitor grass

Daily, weekly, monthly checks, assess for sward length, quality, presence of weeds, damage, topping, management of grazing pressure, boundary maintenance, drainage, rotational grazing, nutrition, weed control and their effects on sward, re-seeding

Grassland improvement activities

Plan and monitor activities, boundary maintenance, rotational grazing/conservation cuts, drainage maintenance, fertiliser application, weed control, partial sward replacement, topping

Unit 315 Understand Grassland Management

Outcome 4 Know how to conserve grass

Assessment Criteria

The learner can:

1. Describe **common systems for grass conservation**
2. Describe the alternative **mechanical methods/treatments for conserving grass**
3. Describe the **processes involved in harvesting and storing conserved grass**

Unit content

Common systems of grass conservation

Field dried hay, wrapped hay/haylage/silage, clamped silage, dried grass
Fertiliser requirements, sward composition, time of cutting, target D value

Mechanical methods/treatments for conserving grass

Mowers and mower conditioners, tedding machines and their uses, wind row machines and their uses, baling machines (conventional, big round and big square), wrapping machines, forage harvesters (self propelled and trailed)

Processes involved in harvesting and storing conserved grass

Principles of preservation by drying (hay), work plan/schedule of events, weather forecasting, mechanical handling, example schedule of events, target moisture content for baling
Principles of preserving grass by wrapping: work plan/schedule of events, weather forecasting, mechanical handling, wrapping, transport and storage, example schedule of events, target moisture content for baling
Principles of preserving grass by clamping: including target pH of made silage, desirable bacterial activity and how to promote it, D Value - work plan/schedule of events, weather forecasting, mechanical handling, wrapping, transport and storage, example schedule of events, target moisture content for baling

Unit 315 Understand Grassland Management

Notes for guidance

This unit deals with the management of grass as a crop. Learners will look at methods of optimising grass productivity though its use both by the grazing animal and for conservation. Care will need to be taken to contextualise the study of grassland production to meet the requirements of the learners in their locality. Different emphasis will need to be placed on dairy cow grazing systems in lowland western areas than in hill farming areas or equine areas. The assignment should be tailored to meet the individual needs of the learner.

Outcome 1 serves as a general introduction to the unit as a whole, but will be common to all areas in the UK. The terminology could be given in the form of a 'dictionary A-Z' at the start of the course so that students have a continual reference point. The growth pattern would ideally be taught to match the season of grass growth, which is likely to be mostly from early spring onwards. The agronomic characteristics of grasses and weeds could be taught both in a laboratory and in the field. Weeds should be observed at their different growth stages, especially when relatively small.

Outcome 2 will need to be taught according to the season of grass establishment, which will be either autumn or spring. It would be useful for students to observe the results of a recent grassland establishment programme in order to base their comments from direct observation. Students should be made familiar with Department for Environment, Food and Rural Affairs (England) (Defra), Welsh Assembly Government (Wales), Scottish Executive Environment and Rural Affairs Department (SEERAD), Department of Agriculture and Rural Affairs (DARD NI) RB209 Fertiliser Recommendations handbook and the updated NVZ guidelines for manure applications. Regular crop walking to monitor weeds, pests and diseases as well as signs of sward deterioration such as poaching will need to be continually borne in mind by the tutor. The unit should therefore contain an equal mix of classroom and field studies.

Outcome 3 will usefully link with other crop units, where soil studies, estate skills such as fencing and machinery sessions such as fertiliser applications are dealt with. Tutors should be encouraged to liaise if possible with a farm's manager where soil index information coupled with an agronomist's report are a feature of farm management, so that students are involved with industry practice. The outcome would lend itself to a student-centred assignment/case study where planning considerations are required. The outcome will involve taught classroom work, student centred work, field walks, practical use of machinery and equipment and laboratory sessions.

Much of Outcome 4 would be taught at the appropriate season, which is likely to be from mid-February onwards, in preparation for the forthcoming grazing and conservation activities. Tutors will possibly need to account for flexibility in following grass growth with respect to the apparent changing seasons and milder winters. Where possible students should be involved in a farms' preparation for both grazing and conservation, especially where silage takes place. There would need to be strict adherence to Health and Safety at all times where machinery and grazing livestock are concerned.

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Unit 316 Understanding Livestock Breeding and Nutrition

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of livestock breeding and nutrition and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand the principles of breeding farm livestock
2. Understand techniques used to enhance livestock reproduction
3. Be able to formulate a ration for selected livestock
4. Be able to evaluate the effectiveness of a feeding plan

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

LP7 Provide feed and water to livestock

LP9 Establish pregnancy and maintain livestock during pregnancy

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 316 Understanding Livestock Breeding and Nutrition

Outcome 1 Understand the principles of breeding farm livestock

Assessment Criteria

The learner can:

1. Discuss the **principles of animal breeding**
2. Explain desirable **selection traits** for a category of farm livestock

Range

Livestock: Two from cattle (meat or dairy), pigs, sheep, goats, poultry (chickens: eggs or meat, ducks, turkeys)

Unit content

Principles of animal breeding

Line breeding, cross breeding, outcrosses, hybrids, breeding lines
Mendelian genetics: Laws of inheritance, monohybrid and di-hybrid crosses, dominance, recessive, mutations, sex determination, gene interaction (e.g. co-dominance, epistasis, sex-linked, multiple alleles, lethal genes), heritable traits
Breed data: Chi-squared probability tests on simple animal breeding data with two pairs of alleles showing dominant and recessive characteristics

Selection traits

Production traits (muscle mass, fat distribution, milk production, disease resistance, growth rates); behaviour, differences in selection of male and female animals, conformation, fertility

Unit 316 Understanding Livestock Breeding and Nutrition

Outcome 2 Understand techniques used to enhance livestock reproduction

Assessment Criteria

The learner can:

1. Discuss the **benefits** of enhancing livestock reproduction
2. Review **natural** and **technological methods** of enhancing livestock reproduction

Unit content

Benefits

Productivity, welfare, health, disease resistance

Natural

Monitoring signs of oestrus, teasers, service management, fertility monitoring, optimising nutrition, light manipulation (if appropriate)

Technological methods

Hormonal control, use of ultrasound scanning, pregnancy diagnosis, artificial insemination, biotechnologies (multiple ovulation and embryo transfer, cloning, in vitro fertilisation, embryo transfer, oocyte sexing, transgenesis)

Unit 316 Understanding Livestock Breeding and Nutrition

Outcome 3 Be able to formulate a ration for selected livestock

Assessment Criteria

The learner can:

1. Identify the **factors** which affect the nutritional requirements of selected **farm animals**
2. Compare the **nutrient content** of a range of **feedstuffs**
3. Create a **ration** for selected **farm animals** to meet their nutritional requirements

Range

Cattle (dairy, beef), poultry (egg laying, meat production), Pigs (breeding, weaners), Sheep (Spring lamb, Store lamb)
Both extensive and intensive production systems should be discussed.

Unit content

Factors

Age, size, purpose for which animals are being kept, health status, sex, pregnancy, lactation, environmental conditions, productivity

Nutrient Content

Water, protein, fat, carbohydrate, vitamins, minerals

Feedstuffs

Natural (seeds, roots, grasses, legumes, fruits and vegetables), commercial feed for the range of life stages, supplements, industrial by-products

Ration

Dietary calculations (dry matter, energy content, distribution of nutrients with emphasis on protein analysis, vitamins and minerals, provision of a balanced ration appropriate to life stage and purpose)

Unit 316 Understanding Livestock Breeding and Nutrition

Outcome 4 Be able to evaluate the effectiveness of a feeding plan

Assessment Criteria

The learner can:

1. Create a checklist for evaluating the **effectiveness of a feeding plan**
2. Carry out **feeding plan evaluation** using checklist.

Unit content

Effectiveness of a feeding plan

Weight gain, muscle to fat ratio, muscle and fat distribution, condition score, health, fecundity, fertility, milk production, growth rates, economy, natality and mortality rates, waste, ease of feed preparation and feeding methods

Feeding plan evaluation

This should be performed practically for one of the animal species previously listed.

Plans should include feed type, quantities and frequency of feeding, timing, records of whether the animal has eaten, supplementation, alternatives to the plan, availability, display of animal feeding requirements

Evaluate against feeding plan objectives, planning activities and resources, monitoring activities and resources, recommendations and improvements

Unit 316 Understanding Livestock Breeding and Nutrition

Notes for guidance

This unit aims to give learners an understanding of the principles of livestock breeding and nutrition, and how these can be applied in practice.

This unit should consider a representative range of livestock species as appropriate (cattle: beef and diary, sheep, pigs, poultry) and should include access for learners to practical sessions to enable evaluation of breeding and nutritional strategies employed in livestock production. Throughout the unit emphasis should be placed on the consideration of animal health, welfare and ethics.

The unit should emphasis the development of underpinning knowledge to enable formulation of reproduction and nutritional strategies for a range of livestock species and production systems, and then contextualise theoretical knowledge via practical application in suitable agricultural environments. Safe working practices and compliance with relevant legislation, codes of practice and health and safety should be emphasised before and during practical work.

In Outcome 1, the learner develops their knowledge of animal breeding with consideration of strategies employed in livestock management for intensive and extensive production species for a range of species. Learners should be able to propose explanations for why chosen strategies are utilised in terms of end product requirements, both historic in terms of breed development and current practices, welfare and ethics. It is envisaged that delivery will be formal but should be complimented by practical visits, videos and guest speakers or links with local farms.

For Outcome 2 learners should be encouraged to analyse the welfare, ethical and production value of livestock reproductive strategies. Learners are required to demonstrate underpinning knowledge of natural and artificial reproductive methodologies, and should be developing a personal viewpoint on the emerging use of biotechnologies in modern livestock production. Again, delivery is expected to be formal but should be complimented by videos and case studies to encourage the learner to explore historic, current and topical issues in livestock reproduction.

Outcome 3 enables the learner to engage in practical formulation of dietary rations to meet the nutritional needs for a range of livestock species and for various life stages. Learners are required to demonstrate knowledge of key nutrients, the importance of a balanced ration, the use of supplementation, compare different feedstuffs and to be able to perform basic energy calculations. Delivery will be formal and practical but must incorporate opportunities for practical formulation of rations for at least two livestock species and learners should be encouraged to actively participate in the delivery of rations.

Outcome 4 develops the learner's ability to evaluate formulated feed rations in terms of animal productivity, health and welfare and waste. Learners will be able to design a checklist that could be used to evaluate the effectiveness of a feed ration and apply their design in a real environment. A combination of formal and practical delivery is essential to enable learners to actively participate in ration delivery and formulation for a range of livestock species. Health and safety, disease control, animal health and welfare and ethics should be highlighted throughout delivery of this outcome.

Learners working towards Level 3 should have underpinning knowledge of reproduction, digestion and nutrition for a wide range of animal species. Knowledge of livestock husbandry would be beneficial. The unit aims to build upon this foundation knowledge to consider reproductive and nutritional requirements for key livestock species with respect to production strategies and end-product requirements e.g. milk yield or intensive versus organic production. Learners should be

exposed to practical environments employing different production methodologies for the range of the species considered to enable consideration of different systems and appropriate strategies employed to secure commercial success. It is important that the learner understands the influence of legislation, Defra, health and safety and bio-security on livestock reproduction and management.

Centres are encouraged to introduce employers and specific professionals from industry to provide interesting and relevant information to the learner. Teaching would also benefit from visits to a range of production systems to add depth to the learner experience.

It is accepted that formal lectures will be necessary at Level 3 but for this unit it is necessary to compliment this with practical opportunities and recommended to introduce interactive sessions in a real environment.

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www.wales.gov.uk	Welsh Assembly Government
www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.fawc.org.uk	Farm Animal Welfare Council
www.hse.gov.uk	Health and Safety Executive
www.iah.ac.uk	Institute for Animal Health
www.lantra.co.uk	Lantra SSC
www.nfu.org.uk	National Farmers Union

Unit 317 Undertaking Root Crop and Field Vegetable Production

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of root crop and field vegetable production and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or onto further/higher education.

The learner will explore the requirements of root crops and field vegetables, consider their harvesting, storage and marketing and carry out practical vegetable growth and husbandry.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know the husbandry requirements of root crops and field vegetables
2. Understand the harvesting, storage and marketing of root crops
3. Understand the harvesting, storage and marketing of field vegetables
4. Be able to carry out root crop and field vegetable production

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

AgC11 Prepare planting equipment and plant extensive crops
AgC12.2 Prepare harvested crops

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 317 Undertaking Root Crops and Field Vegetable Production

Outcome 1 Know the husbandry requirements of root crops and field vegetables

Assessment Criteria

The learner can:

1. Identify the **soil and climate** requirements for selected root crops and field vegetables
2. Describe the **husbandry requirements** of selected root crops and field vegetables.

Range

Crop types: major crops (national, local and geographic distribution)
Definitions: annual, biennial, perennial, multi-annual, perishable
Root crops to include potatoes, beet, carrots, turnips, parsnips
Vegetables to include brassicas, pulses, leeks, onions

Unit Content

Soil and climate

Climate: precipitation, temperature, sunlight, wind speed
Soil requirements: soil type, drainage and structure, soil pH, nutrients, topography

Husbandry requirements

Establishment: seedbed requirements, cultivation techniques, vegetative reproductive material, spacing, seed rates, pre-planting techniques, planting sequence, time management, protected cropping
Nutrition: methods of calculating crop requirement, specific crop requirements, legislation and codes of practice
Crop protection: identification of weed, pests and diseases, control methods, legislation and codes of practice, timeliness
Irrigation requirements: water availability, crop requirements and application methods

Unit 317 Undertaking Root Crops and Field Vegetable Production

Outcome 2 Understand the harvesting, storage and marketing of root crops

Assessment Criteria

The learner can:

1. Explain the **organisation of harvesting and storage** of selected root crops to meet market requirements
2. Compare the **gross margins** for two named root crops.

Range

Root crops to include potatoes, beet, carrots, turnips, parsnips

Unit content

Organisation of harvesting and storage

Harvesting: pre-harvest treatments, minimising damage and losses, harvester adjustment, labour, time management

Conditioning: cooling, curing, timeliness, quality and grading

Storage: store management, monitoring equipment, pest and disease control, maintaining the crop in a saleable condition

Loading and transportation: field to store, within store, store to customer

Gross margin

Calculation of gross output for crop less variable costs

Variable costs include seed, fertiliser, casual labour, contract work, and sprays (those costs directly attributable to particular crop)

Unit 317 Undertaking Root Crops and Field Vegetable Production

Outcome 3 Understand the harvesting, storage and marketing of field vegetables

Assessment Criteria

The learner can:

1. Explain the **organisation of harvesting and storage** of selected field vegetables to meet market requirements
2. Compare the **gross margin** for two named field vegetables.

Range

Vegetables to include brassicas, pulses, leeks, onions

Unit content

Organisation of harvesting and storage

Harvesting: pre-harvest treatments, minimising damage and losses, harvester adjustment, labour, time management

Conditioning: cooling, curing, timeliness, quality and grading

Storage: store management, monitoring equipment, pest and disease control, maintaining the crop in a saleable condition

Loading and transportation: field to store, within store, store to customer, direct sales

Gross margin

Calculation of gross output for crop less variable costs

Variable costs include seed, fertiliser, casual labour, contract work, and sprays: those costs directly attributable to particular crop

Unit 317 Undertaking Root Crops and Field Vegetable Production

Outcome 4 Be able to carry out root crop and field vegetable production

Assessment Criteria

The learner can:

1. Carry out specified **husbandry** tasks for selected root crops and field vegetables
2. Calculate the **physical and financial performance** of selected root crops and field vegetables.

Range

Root crops to include potatoes, beet, carrots, turnips, parsnips
Vegetables to include- brassicas, pulses, leeks, onions

Unit Content

Husbandry

Soil preparation, crop establishment- sowing/planting, crop maintenance and management to include weeding, fertiliser application, irrigation if applicable, harvesting and into store

Physical and financial performance

Physical: yield per hectare, yield compared to published data, labour hours, tractor/machine inputs, work rates, field efficiency and work rates
Financial: gross margin, gross margin compared to published data, direct costs of inputs, fixed costs

Unit 317 Undertaking Root Crops and Field Vegetable Production

Notes for guidance

This unit is designed to provide the learner with the knowledge, skills and experience to produce root crop and field vegetables on a commercial scale. Root crop and vegetable production is an important sector of agriculture in some parts of the UK, offering enterprises that can generate a high income per hectare for land-based businesses.

Much of the machinery, storage facilities and skills required for the crops studied in this unit are of a highly specialist nature, making detailed knowledge essential.

Tutors delivering this unit will have the opportunity to use as wide arrange of delivery techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised practicals, internet and or library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

It is essential that tutors stress the importance of sound environment management and the need to manage the resource using approved methods.

Health and safety issues relating to working in and around machinery must be stressed and regularly enforced, and risk assessments must be undertaken prior to practical activities. Adequate Personal Protective equipment (PPE) must be provided and used.

Outcome 1 covers the husbandry requirements of root and field scale vegetable crops. The leaner will gain a broad knowledge of the soil and climate requirements for these crops and the specific requirements for selected crops. Husbandry requirements covers all aspects from planting through to harvest and it would be ideal if the learner was involved with a crop throughout its production cycle .This outcome is likely to be delivered through a combination of lectures, discussions, site visits, independent learner research and supervised practical sessions.

Outcome 2 gives the learner the opportunity to understand the harvesting, storage and marketing of root crops. This varies significantly between crops and a range of crops should be studied. This outcome is likely to be delivered through a combination of lectures, discussions, site visits, independent learner research and supervised practical sessions. It would be ideal to follow a specific crop or crops through their production cycle.

Outcome 3 gives the learner the opportunity to understand the harvesting, storage and marketing of field vegetable crops. This varies significantly between crops and a range of crops should be studied. This outcome is best supported by site and store visits. This outcome is likely to be delivered through a combination of lectures, discussions, site visits, independent learner research and supervised practical sessions. It would be ideal to follow a specific crop or crops through their production cycle.

In Outcome 4 the leaner can gain practical skills in the production of root crop and field vegetables. Emphasis here must be on safe working practice. This is likely to be delivered by practical session combined with supporting in class activities and lectures. Where possible the use of work experience would enhance delivery. Outcome 4 also enables the learner to understand, review and compare physical and financial information. The leaner should gain the skills required to calculate these and to compare them to standard and published data. In so doing they can compare and

evaluate their own crop physical and financial data. Yield per hectare, inputs, field efficiency and work rate calculations should form part of the physical information calculated.

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Other Reading

Anon- Recommended List of Potatoes (NIAB farmers' leaflet, latest edition)

Anon- Recommended List of Sugar Beet (NIAB farmers' leaflet, latest edition)

Anon- Recommended List of Field vegetables (NIAB farmers' leaflet, latest edition)

Anon- The Leaf Handbook for Integrated Farm Management (LINKING Environment and farming, 2000)

Journals

Arable Farming
British Sugar Review
Crops
Farmers Weekly
Landwards- IAgrE

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www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.wales.gov.uk	Welsh Assembly Government
www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.environment-agency.gov.uk	Environment Agency
www.potato.org.uk	British Potato Council

Unit 318 Undertake Land-based Industries Pollution and Waste Control Management

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of land-based industries pollution and waste management control and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

The learner will develop the knowledge of sources of farm waste, environmental legislation relevant to waste disposal, how to make optimum use the nutrient content of organic waste and methods of waste disposal to help equip enterprise managers for their future career.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand the source and attributes of organic and inorganic waste
2. Know the scope of waste management legislation and regulation
3. Know how to manage waste in a farm environment
4. Be able to safely dispose of waste in a farm environment

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

EC2 Survey and report on the condition of the environment
EC9 Contribute to restoring polluted environments to acceptable conditions
EC22 Monitor and report on environmental change

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 318 Undertake Land-based Industries Pollution and Waste Control Management

Outcome 1 Understand the source and attributes of organic and inorganic waste

Assessment Criteria

The learner can:

1. Explain **sources of organic and inorganic** wastes and their attributes in a given situation
2. Discuss **factors that influence the quantity of waste**

Unit content

Sources of wastes

Wastes from animal and crop production processes for example soiled bedding from livestock enterprises, waste plant material from crop processing

Chemicals (including medicines, herbicides, pesticides and fungicides)

Organic and inorganic wastes

Organic: farmyard manure, hay, straw and silage, slurry, wood, soil, animal carcasses

Inorganic: including plastics, metal, glass, inert waste, oils and fuel, hazardous wastes

Factors that influence the quantity of waste

Waste treatment, compaction/consolidation, value as saleable material (re-use, recycling and recovery)

Packaging, amount of livestock, efficiency of systems and processes (e.g. spillage, leaks), over-production

Unit 318 Undertake Land-based Industries Pollution and Waste Control Management

Outcome 2 Know the scope of waste management legislation and regulation

Assessment Criteria

The learner can:

1. Describe selected current **legislation** and **codes of practice** that control the **storage, handling and disposal** of farm waste
2. Outline **constraints** current regulations place on a waste management and husbandry system

Unit content

Legislation and codes of practice

Legislation: The Environmental Protection Act 1990, The Environment Act 1995, The Environmental Protection (Duty of Care) Regulations 1991, The Waste Management Licensing Regulations 1994 (and amendments 1995), The Control of Pollution (Amendment) Act 1989, The Framework Directive on waste, Scrap Metal Dealers Act 1964, The Controlled Waste Regulations 1992, The Civic Government (Scotland) Act 1982.

Codes of practice: Waste Management, The Duty of care, The Waste Electronic and Electrical Equipment Directive

Storage, handling and disposal

Responsibility of waste producer, carrier and processor(s), registration and waste licensing, correct storage and handling procedures

Constraints

Cost implications of untreated wastes, disposal and pollution, penalties for improper disposal

Unit 318 Undertake Land-based Industries Pollution and Waste Control Management

Outcome 3 Know how to manage waste in a farm environment

Assessment Criteria

The learner can:

1. Describe appropriate **methods for the management** of organic and inorganic farm waste in accordance with relevant legislation and regulation
2. Outline **storage and disposal facilities** for organic and inorganic farm waste in a given situation

Unit content

Management methods

Waste reduction programme, waste segregation, separation, compaction, dilution, records/waste codes

Storage and disposal facilities

Bunded areas for liquid wastes, bins and waste skips, composters, anaerobic digesters, incinerators, compactors, cardboard, paper and plastics baling machinery, pelleters, shredders and chippers, rendering plant, decontamination equipment, slurry/muck store, landfill

Unit 318 Undertake Land-based Industries Pollution and Waste Control Management

Outcome 4 Be able to safely dispose of waste in a farm environment

Assessment Criteria

The learner can:

1. Demonstrate the safe **disposal of selected organic farm waste** in accordance with a given waste management plan
2. Prepare a waste **management plan** for organic and inorganic waste in a given situation

Unit content

Disposal of selected organic farm waste

Direct application (farmyard manures and slurry), composting, bio-digesting etc, burning (energy from waste), hazardous waste treatment prior to disposal, animal carcases, transporting of waste off site

Management plan

Risk assessments, analysis of all farm wastes from production to disposal, amounts, records of compliance

Unit 318 Undertake Land-based Industries Pollution and Waste Control Management

Notes for guidance

This unit is designed to provide the learner with the knowledge and skills required to control and manage and dispose of waste in a farm environment.

Throughout the unit, the emphasis should be on safe working. It is expected that learners will be aware of safe working practices and familiar with accepted practices and behaviours within the context in which they are working.

Outcome 1 requires the learner to identify different types of waste and the origins of these. It is also expected that they will be able to define organic and inorganic wastes. Some formal delivery of this is expected but learners should also be given opportunities to observe and identify wastes in a practical setting. Care must be taken to ensure that safe working practices are implemented including the use of appropriate Personal Protective Equipment (PPE), machine operation by qualified operatives and secure storage of wastes.

Outcome 2 examines the legislation and regulation associated with waste and waste management. It is not expected that learners have a detailed knowledge of all relevant legislation and regulation but they should be aware of the scope of these. Learners should be aware of the importance of keeping accurate and up to date records on the amounts and types of waste. The constraints that the legislation and regulation places on waste producers need to be considered in the context of developing a waste management plan.

Outcome 3, learners should be able to plan for managing waste appropriately. They should understand the importance of waste control and reduction as an alternative to direct disposal to landfill. The development of a waste management plan should describe how waste is dealt with including strategies for reduction and control.

Outcome 4, learners should be able to demonstrate their ability to dispose of waste safely in a practical/realistic context. Safe working practices must be observed and risk assessments carried out prior to any practical activity which involves handling, treatment and disposal of waste.

This unit lends itself to a variety of teaching techniques and it is expected that as well as formal lectures, learners will benefit from a range of practical tasks, site visits and guest speakers. For example, site visits to landfill sites, farms and recycling facilities, guest speakers from organisations such as the Environment Agency and practical waste disposal activity could be utilised.

References

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The Waste Strategy for England (2007). Defra publication. TSO.

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www.wales.gov.uk	Welsh Assembly Government
www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.ciwm.co.uk	Publications from The Chartered Institute of Wastes Management (CIWM).
www.environment-agency.org.uk	The Environment Agency
www.wrap.org.uk	The Waste and Resources Action Programme (WRAP)

Unit 319 Undertaking Farm Habitat Management

Level: 3

Credit value: 10

Unit aim

This unit aims to introduce learners to farm habitat management skills and knowledge and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Upon completion of this unit the learner will have looked at changes in the farmed landscape since the Enclosures Acts, the various influences on and effects of these changes. They will consider ecological aspects of farm habitat management. They will develop skills in farm habitat surveying and practical habitat management.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand the development of the agricultural landscape
2. Understand the ecology of farm habitats and wildlife species
3. Be able to carry out farm habitat and species surveys
4. Be able to carry out practical farm habitat management

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

EC23 Prepare and conduct field surveys

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 319 Undertaking Farm Habitat Management

Outcome 1 Understand the development of the agricultural landscape

Assessment Criteria

The learner can:

1. Explain the development of the **agricultural landscape** in the UK
2. Explain effects of **legislation or policy** on the development of the farmed landscape

Unit content

Agricultural landscape

Primeval, medieval, pre-enclosure, enclosure, industrial revolution, post 1940's, modern day agriculture

Legislation or policy

The General Enclosures Act 1845, Corn Laws, Agricultural Act 1947, Common Agricultural Policy (CAP), Wildlife and Countryside Act 1981 (as amended), Environmental Protection Act 1990, Cross Compliance Nitrates Directive 1991, Hedgerows Regulations 1997, Environmental Impact Assessment (Agriculture) (England) Regulations 2006
Ecological effect: change to species diversity, range and distribution, change to habitat types and characteristics, impact of intensive agricultural management

Unit 319 Undertaking Farm Habitat Management

Outcome 2 Understand the ecology of farm habitats and wildlife species

Assessment Criteria

The learner can:

1. Explain the **ecological importance** of **habitat** diversity in a selected farmed landscape
2. Evaluate the effectiveness of a given **biodiversity action plan**

Range

Habitat: hedges, stone walls, ponds and lakes, rivers and streams, woods, trees, field margins, conservation headlands and grasslands

Unit content

Ecological importance

Provision of habitat for a diverse range of species (flora and fauna), rare and uncommon species, species with specific habitat requirements, availability and access to food preferences

Biodiversity action plans

Habitat Action Plans (HAPs), for example ancient and or species rich hedgerows action plan, cereal field margin action plans, grassland action plans, species action plans, ecological importance of habitat diversity in the farmed landscape, process of species and habitat action planning

Unit 319 Undertaking Farm Habitat Management

Outcome 3 Be able to carry out farm habitat and species surveys

Assessment Criteria

The learner can:

1. Carry out ecological **surveying** of a given **farm habitat**
2. **Report results** of **farm habitat** and **species** surveying

Unit content

Surveying

Whole farm assessments, Linking Environment and Farming (LEAF) audit, Farm Environmental Record, Farm Environmental Plans (Environmental Stewardship Scheme), National Vegetation Classification, hedgerow survey, farmland bird surveys, arable plants survey, farmland species, ecological features, nature conservation value, habitat condition assessment, potential biodiversity improvements

Farm habitats

Hedges, stone walls, ponds and lakes, rivers and streams, woods, trees, field margins, conservation headlands, and grassland

Report results

Qualitative and quantitative, suitable presentation methods (for example tables, pie charts, annotated maps, histograms, scattergraphs), statistical analysis to include mean, mode, distribution and correlation, establishing conclusion in relation to survey aims, identify potential sources of error within survey data

Species

Birds, mammals, invertebrates, grasses, shrubs, trees, wildflowers

Unit 319 Undertaking Farm Habitat Management

Outcome 4 Be able to carry out practical farm habitat management

Assessment Criteria

The learner can:

1. Prepare **equipment** and resources for practical management of **farm habitats**
2. Carry out **practical management** techniques safely
3. Recommend **improvements** to the management of farm habitats

Unit content

Farm habitats

Hedges, stone walls, ponds and lakes, rivers and streams, woods, trees, field margins, conservation headlands and grasslands

Equipment

Hand tools: spades, forks, shovels, secateurs, handsaws, clippers, hammers, pickaxes, hand fencing equipment, safe and correct use, maintenance and storage, sharpening of tools where appropriate, suitable clothing and Personal Protective Equipment (PPE)

Practical management

Mowing, renovation, planting and staking as applicable, clearing (path, fence line), coppicing, uprooting, hedge maintenance, pruning, thinning, cutting or mowing and mulching, pond, stream and ditch clearance

Good practice: composting, materials that can be composted, re-used and/or recycled, finding alternative uses, methods of recycling, avoid wastage

Improvements

Setting habitat management objectives, planning activities and resources, monitoring activities and resources, reviewing outcomes against objectives, recommendations and improvements

Unit 319 Undertaking Farm Habitat Management

Notes for guidance

Upon completion of this unit, the learner will have looked at changes in the farmed landscape from Primeval Time and the various influences on it, and effects of these changes. They will consider ecological aspects of farm habitat management. They will develop skills in farm habitat surveying and practical habitat management.

Delivery is likely to be a mixture of classroom learning and practical farm habitat surveying and management. Any sites to be used needs to comply with local legislation and have prior full permission from the landowner.

Where practical activities are used health and safety issues relating to working in an outdoor environment and handling animal material must be stressed and regularly reinforced, and risk assessments must be undertaken and recorded prior to practical activities. Adequate Personal Protective Equipment (PPE) must be provided. It is important that all learners are familiar with the tools, equipment, protocols and methods to be used in order to collect accurate data safely.

Outcome 1 requires the learner to understand the development of the agricultural landscape and how this has altered from Primeval Time to the present day. They will be required to consider the influence of UK legislation and policies, effects of global and national events, and the changes to farming practices. This would include learners identifying biotic and abiotic effects e.g. how the removal of hedges, ditches, ponds, woodland, farm buildings, dry stone walls, grading of the watercourse, the use of pesticides and inorganic fertilisers, silting of water courses via soil erosion have affected the landscape. As well as classroom activity learners would benefit from practical sessions and visits to enhance learning and understanding. Tutors should be encouraged to use local sites wherever possible. Theory delivery can be through a series of formal lectures, directed study, internet and library associated research.

Outcome 2 requires the learner to understand farm habitats and wildlife species. Tutors should be encouraged to use local sites wherever possible. The outcome takes into consideration the influence of farm biodiversity, e.g. local and national Biodiversity Action Plans (BAP) as well as the biodiversity action planning process. The emphasis of the unit is for learners to explore the elements of the landscape occupied by semi natural habitats. Theory delivery can be through a series of formal lectures, directed study, internet and library associated research.

Outcome 3 requires the learner to practically plan, carry out and report findings of farm habitat and species surveys. Learners are required to identify plant and animal species present as well as making assessments on the condition of the farm habitats and making suggestions as to ways these could be improved. It is anticipated that there will be some group activities during surveying but learners are encouraged to present their findings individually.

Outcome 4 requires the learner to plan and use equipment and resources to recommend and carry out practical farm habitat management and to devise a management scheme taking into account the needs of the sites they access. It links well into the previous outcomes where the learners have gained practical skills and knowledge to complete the task. The site to be used needs to comply with local legislation and have prior full permission from the landowner prior to implementing change.

Work experience would be beneficial for learners wishing to pursue a career in this field. Visits from visiting speakers could add relevance to the subject including their work the situations they face and the methods they use.

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Unit 320 Undertaking Land-based Machinery Operations

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of land-based machinery operations and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

The learners will study the purpose and operation of land-based machines including machine layout, systems and controls. They will explore daily checks and adjustments as well as appropriate Personal Protective Equipment and the legal and recommended requirements for land-based machinery. They will learn how to safely operate and maintain machinery and consider the different conditions in which machinery might need to operate.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand the purpose and operation of land-based machines
2. Be able to prepare land-based machines ready for work
3. Be able to safely operate land-based machinery
4. Be able to carry out operator maintenance and simple repairs

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

CU28 Prepare for and maintain equipment and machines

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 320 Undertaking Land-based Machinery Operations

Outcome 1 Understand the purpose and operation of land-based machines

Assessment Criteria

The learner can:

1. Explain the purpose and **safe operation** of selected land-based machines
2. Discuss the **differences between selected land-based machines**

Range

A range of modern land-based machines designed for the production of a seedbed, cutting or handling of grass swaths, application of materials, harvesting of crop

Unit content

Safe operation

Need for operator training, certification process, Health and safety at Work etc Act1974, Provision and Use of Work Equipment Regulations 1998 (PUWER), Environment Act 1995, Control of Substances Hazardous to Health 2002 (COSHH), Personal Protective Equipment (PPE), manual handling, risk assessments, codes of practice

Differences between Land-based machines

Trailed or mounted, powered or non powered, mechanical, electric or hydraulic powered, wheels, skids or hydraulic pressure accumulation, cutting, gathering, conveying; belts, chains, shaft drives; vacuum, pressure, gravity; swath width, bout width, row width, depth control

Unit 320 Undertaking Land-based Machinery Operations

Outcome 2 Be able to prepare land-based machines ready for work

Assessment Criteria

The learner can:

1. **Prepare selected land-based machinery** ready for work safely
2. Review the **pre-start checks** and **safety requirements** for selected land-based machinery

Range

A range of modern land-based machines designed for the production of a seedbed, cutting or handling of grass swaths, application of materials, harvesting of crop

Unit content

Prepare selected land-based machines

Power unit suitability, removal from storage, cleaning, damage inspection, correct hitching, free movement of working components/controls, connection to power unit, wheel and tyre maintenance, braking and lighting requirements, lubrication, calibration, tying/wrapping materials, initial field settings

Pre-start checks

Power drive shaft condition, decontaminated, safety overload devices, fuel/oil requirements, tyre pressures and conditions, lighting controls including brakes, belt tensions

Safety requirements

Guards, safety rails, steps, safe attachment to power unit, component security, information decals

Unit 320 Undertaking Land-based Machinery Operations

Outcome 3 Be able to safely operate land-based machinery

Assessment Criteria

The learner can:

1. **Operate** selected land-based machinery to meet given objectives safely
2. Explain the **safe operation** of selected land-based machinery

Range

A range of modern land-based machines designed for the production of a seedbed, cutting or handling of grass swaths, application of materials, harvesting of crop

Unit content

Operate

Site risk assessments, PPE, operator instruction manual, data sheets, transport/field settings, calibration check, correct power engagement, correct machine speeds, safe/correct loading of materials, machine output checks/quality of work, field procedures, terrain, ground conditions/undulations, public access

Safe operation

Health and Safety at Work etc Act (1974), follow manufacturers' recommendations, dealer installation process, operator instruction manuals, manufacturer web sites

Unit 320 Undertaking Land-based Machinery Operations

Outcome 4 Be able to carry out operator maintenance and simple repairs

Assessment Criteria

The learner can:

1. Carry out **operator maintenance** and appropriate **repairs** for selected land-based machinery
2. Assess **potential faults** and/or **defective parts** on a given land-based machine

Range

A range of modern land-based machines designed for the production of a seedbed, cutting or handling of grass swaths, application of materials, harvesting of crop

Unit content

Operator maintenance

Manufacturers' service schedules/instructions, lubrication, cleaning, assessment of wear tolerances, component replacement disposal of waste

Repairs

Framework welds, joints, distortion, fractures, leaking pipes, connections

Potential faults

Uneven groundwork, crop damage, inaccurate outputs, incorrect linkage settings, incorrect drawbar settings, uneven tyre pressures, incorrect track widths, power unit unsuitable, blockages

Defective parts

Belts, chains, bearings, loose splines, shares/tines, blunt/missing knives, rotor balance, nozzles/filters, and seals

Unit 320 Undertaking Land-based Machinery Operations

Notes for guidance

This unit is designed to give learners knowledge, understanding and practical skills to enable them to recognise and understand the working principles of land-based machines typically used in their area of study.

Learners will be able to demonstrate pre start checks, initial settings and safe start up techniques for a range of selected machines prior to connecting the machine to a suitable power unit and preparing machine and power unit for work. An emphasis will be put on the correct use of manufacturers' recommended procedures and respect for health and safety issues and conformation of relevant safe working practices.

It is envisaged that all learners, prior to studying this unit will have received training in the use of tractors and have been assessed as having reached a level of competence to allow practical tasks to be demonstrated safely. Learners must show awareness and consideration of hazards and risks at all times, particularly during fieldwork situations where levels of risk may vary ay any given time.

Where possible, non-simulated field work should be programmed into the learning period to take into account seasonal opportunities. Following field operations, learners will demonstrate simple maintenance and pre storage tasks to minimise degeneration of the machine and to ensure the machine is in a useable condition for subsequent operations.
The range of machinery covered should include electric vehicles and machines if appropriate.

In Outcome 1, learners must demonstrate knowledge and understandings of the construction and working principles of a selection of Land-based machines commonly used in their area of study and demonstrate knowledge of the work and performance parameters of such machines.

In Outcome 2, learners will demonstrate an ability to prepare the machine for field operations and ensure that the machine is matched and correctly connected to a suitable power unit. Machines are to be selected from the 'range/scope' list outlined in the unit content. It is essential that manufacturers' recommendations be followed to enable machines to be initially set to achieve given fieldwork criteria.

In Outcome 3, learners will need to explain safe operational procedures and carry out risk assessment prior to engaging in fieldwork. Suitable field procedures are to be demonstrated, regular checks to be made on machine performance and necessary adjustments made to both machine and power unit to meet given fieldwork criteria economically and efficiently.

In Outcome 4, following fieldwork operations, learners must carry out pre-storage maintenance, carry out an inspection to identify and subsequently rectify any faults. Wearing components will need to be assessed and replaced if wear limits are reached. Throughout the unit the emphasis will be on safe, legal practices, working to manufacturers' recommended procedures and attention to detail when recording information.

Depending on the Land-based area the learner is studying, formal lecture delivery may be generic to all areas but practical experiences and learning should be appropriate to the area of study.

References

Books

Balls, R. 1985. Horticultural Engineering Technology: Field Machinery. Hampshire: Palgrave Macmillan. ISBN 0333364341

Bell, B. 2008. *Farm Machinery*. Ipswich: Old Pond Publishing. ISBN 1903366682.

Culpin, C. 1992. *Farm Machinery* 12th ed. Sussex: Wiley Publishing. ISBN 063203159X

Journals

Farmers Weekly
Amenity Machinery and Equipment
Profi International

Websites

www.hse.gov.uk Health and Safety Executive
Manufacturer's websites

Unit 321 Undertaking Land-based Workshop Practice

Level: **3**

Credit value: **10**

Unit aim

This unit aims to provide learners with an understanding of the principles of land-based workshop practice and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

The aim of this unit is to provide learners with skills, knowledge and understanding to enable them to identify and carry out safe and efficient repair or replacements to worn or damaged land-based equipment components.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know the importance of health and safety and safe working practices within a workshop environment
2. Be able to use hand tools, joining and cutting equipment commonly in land-based maintenance workshops
3. Understand selection and use of materials suitable for purpose
4. Be able to maintain, replace or repair worn or broken components in a land based situation

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

CU28 Prepare for and maintain equipment and machines

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 321 Undertaking Land-based Workshop Practice

Outcome 1 Know the importance of health and safety and safe working practices within a workshop environment

Assessment Criteria

The learner can:

1. Identify **potential hazards** in a land-based maintenance workshop
2. State the range of **legislations** and/or **codes of practice** that apply to given workshop operations
3. State **reasons for the need to follow legislation and safe working practices** in the workshop environment

Range

Land based maintenance workshop where several staff are operating. Workshop where routine and non routine maintenance, fabrication and joining may be carried out at the same time

Unit content

Potential hazards

Fumes, sparks, combustion of materials, faulty equipment, blocked access/egress, lifting heavy components, unsafe working area, slipping, tripping, electric cables

Legislations

Health and Safety at Work etc Act 1974, Provision and Use of Work Equipment Regulations (PUWER) 1998, Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR)1995, Control of Substances Hazardous to Health Regulations (COSHH) 1998, Grinding Wheels Regulations

Codes of practice

Personal Protective Equipment (PPE), machine guarding, company health and safety policy, first aid policy, reporting procedures, personal hygiene facilities, housekeeping policies, waste storage/disposal policy, fire exits and procedures

Reasons for the need to follow legislation and codes of practice:

Personal health and safety, legal requirements, injury to bystanders, work efficiency, location of tools and equipment, accountability for work done

Unit 321 Undertaking Land-based Workshop Practice

Outcome 2 Be able to use hand tools, joining and cutting equipment commonly in Land-based maintenance workshops

Assessment Criteria

The learner can:

1. Identify a range of **hand tools** and joining and cutting equipment used in land-based maintenance workshops and state their purpose
2. Safely use a given range of hand tools and **joining** and cutting **equipment**
3. Demonstrate safe and correct **maintenance procedures** for a given range of hand tools and joining and cutting equipment

Range

Workshop where routine and non routine maintenance, fabrication and joining may be carried out at the same time

Unit content

Hand tools

Hammers, spanners, wrenches, drivers, marking out tools, punches, pullers, measuring equipment

Joining equipment

Non-thermal: Riveting, adhesives, threaded fasteners

Thermal: manual metal arc, metal inert gas, oxy/acetylene, soldering

Cutting equipment

Hand and powered hacksaw, chisels, files, shears, bench and hand held grinders, drills, oxy/acetylene cutting

Maintenance procedures

Hand tool cleaning and storage, transportation, sharpening cutting tools, correct angles, replacement grinding/cutting discs, electrical equipment observation, electrical testing requirements

Unit 321 Undertaking Land-based Workshop Practice

Outcome 3 Understand selection and use of materials suitable for purpose

Assessment Criteria

The learner can:

1. Identify a range of **materials** commonly used for the repair of land-based equipment
2. **Justify the selection of material(s)** to meet given repair objectives
3. **Compare** the use of selected **materials** for given repair situations

Unit content

Materials

Metallic: ion, steel, copper, brass, aluminium, cast iron, lead, bronze

Non- metallic: wood, rubber, plastics, fibres, paper

Justify the selection of material(s)

Ease of use, cost, surface finish, self lubrication, weight, resistance to wear, oxidation resistance, conductivity, heat resistance

Compare materials

Hardness, brittleness, ductility, workability, strength, cost, durability

Unit 321 Undertaking Land-based Workshop Practice

Outcome 4 Be able to maintain, replace or repair worn or broken components in a land-based situation

Assessment Criteria

The learner can:

1. Inspect a selected land-based machine to identify the need for safe repair or **replacement** of identified worn or damaged components
2. Prepare tools and materials and safely **repair** or replace worn or damaged land-based equipment components to meet given specifications
3. Make recommendations for possible **changes to repair and component replacement procedures** carried out on a selected land-based machine

Range

Choose from the following, plough, cultivation machine, grass cutting machine, planting/ sowing/spreading machine

Unit content

Replacements

Worn components, damaged components, bearings, bushes, seals

Repairs

Broken welds, framework fractures, re-alignments, re-fabrications

Changes to repair and component replacement procedures

Strengthening of weak areas, heavier duty materials, gussets, braces, manufacturer updates/modifications to wearing components, improvement to lubrication, reduction of vibration, spreading load

Recommendations for changes to procedures: to reduce time, save costs, improve working conditions, improve longevity, improve effectiveness

Unit 321 Undertaking Land-based Workshop Practice

Notes for guidance

This unit is designed to give the learners the necessary knowledge and skills to detect and rectify faults on a range of land-based equipment typical to their area of study. A suggested range is listed in the range/scope details in outcome four.

It is important that learners are closely supervised when working in a workshop environment and follow safe working practices at all times and that risk and hazards are assessed prior to any activity commencing.

The use of manufacturer's handbooks should be emphasised throughout both for the equipment to be repaired and maintained and also for the tools and equipment used.

Outcome 1 enables the learner to demonstrate an awareness of health and safety issues which affect themselves and others in the workshop situation. An understanding of codes of practice and company policies must also be understood. The learner will also be required to identify potential hazards in a maintenance workshop and ways of minimising those hazards. An understanding of the legislation covering workshop activity and equipment maintenance is also necessary, as is the need for safe working practices and the identification of safe systems of work. The learner must be aware of the required personal protective equipment Personal Protective Equipment (PPE) required for a task and this must be provided and worn; potential risks must be minimised.

Outcome 2, learners will be able to identify a range of hand-tools, joining and cutting equipment. The learner will be able to select and safely and efficiently use appropriate tools and equipment for given tasks. These tasks will include both the use of hand-tools and equipment for thermal and non-thermal joining. All tools used will be inspected, maintained and correctly stored by the learners for subsequent use. It is essential that the learner wears the appropriate (PPE) and adheres to safe working practice.

Outcome 3, learners will be able to identify a range of materials and select the most appropriate material to complete a repair process. The learner will need to understand material properties to be able to make the appropriate choice. Materials to be identified and their properties understood include both metallic and non-metallic material such as plastics and rubber. Selection factors will include ease of working and cost as well as inherent properties such as ductility, strength and hardness. The learner will be able to compare different materials and their possible uses.

Outcome 4, requires the learner to be able to maintain equipment and to replace or repair worn or broken components. The learner must demonstrate safe practices, and conform to legislation while undertaking selected repair/replacement tasks. On completion of the tasks learners will verify their own work and comment on alternative replacement/repair strategies, should the problem reoccur.

Throughout the unit the emphasis will be on safe, legal practices, working to employers' recommended procedures and attention to detail when verifying completed work.

It is accepted that some formal lectures will be necessary, however it is recommended that these are linked to considerable interactive practical lessons in a real working environment.

Centres are encouraged to introduce employers and specific professionals to provide interesting and relevant information to the learner. Teaching would also benefit from visits to a variety of workshops and dealers to add depth to the learner's experience.

References

Books

Bell, B. 1992. *Farm Workshop*. 2nd ed. Ipswich: Farming Press. ISBN 0852362374

Farmers Weekly. 1979. *Farm Workshop and Maintenance*. 2nd ed. London: Crosby Lockwood. ISBN 0246120193.

Pearce, A. 2007. *Farm and Workshop Welding*. 2nd ed. Ipswich: Old Pond Publishing. ISBN 1905523300.

Journals

Profi International
Farmers Weekly
Farm Ideas

Websites

www.hse.gov.uk	Health and Safety Executive
www.twi.co.uk	The welding Institute

Unit 322 Undertaking Specialised Land-based Workshop Practices

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of specialised land-based workshop practice and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further/higher education.

The learner will be introduced to the range of specialised workshop tools, equipment and materials as well as methods associated with new technology used in the land-based sector. They will learn the safe uses and function of these and how to undertake repair tasks. They will also consider correct care and storage of tools, equipment and materials in relation to manufacturer's recommendations and legislation.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Be able to identify and select specialised tools, equipment and processes
2. Be able to use specialised tools and equipment in a safe and competent manner
3. Be able to carry out specialised maintenance and repair tasks.
4. Understand the need for correct care and storage of specialised tools, equipment and materials.

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

CU27 Maintain equipment and machines

L27 Use and maintain equipment and machines

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignments covering practical skills and underpinning knowledge

Unit 322 Understanding Specialist Land-based Workshop Practices

Outcome 1 Be able to identify and select specialised tools, equipment and processes

Assessment Criteria

The learner can:

1. Identify and select appropriate **specialist tools, joining, cutting equipment, fasteners** and **finishes** for given situations
2. Describe the function of **specialist tools, joining, cutting equipment, fasteners** and **finishes**

Range

All learning disciplines: the range of specialist tools and equipment to measure and carry out critical settings on machines and equipment, typical to the area of study, which involve a higher level of technology, technical strategies or techniques

Unit Content

Specialist tools

Measuring aids feeler gauges, vernier callipers, fluid pressure measurement, heat measurement, torque wrench and amplifiers, multimeter, thread restorations, thread gauges, thread files, tap and die set

Joining equipment

Manual Metal Arc (MMA), Metal Inert Gas (MIG) and oxy fuel welding equipment, riveting, pop rivets, chemical adhesives, specialist fasteners, locking devices

Cutting equipment, fasteners

Oxy/fuel cutting and heating - power hacksaw, band saw, cutting/grinding discs

Finishes

Paint finish, oxides, ground coats, gloss and powder coating- plating/galvanise finish,
bare metal protection

Unit 322 Understanding Specialist Land-based Workshop Practices

Outcome 2 Be able to use specialised tools and equipment in a safe and competent manner

Assessment Criteria

The learner can:

1. **Safely use selected specialist tools, joining, cutting equipment, test equipment, fasteners and finishes** for given situations
2. Safely set up and **install replacement components** in selected specialist tools, joining and cutting equipment

Range

All learning disciplines- the range of specialist tools and equipment to measure and carry out critical settings on machines and equipment, typical to the area of study, which involve a higher level of technology, technical strategies or techniques

Unit content

Specialist tools

Measuring aids, feeler gauges, vernier callipers, fluid pressure measurement, heat measurement, torque wrench and amplifiers, multimeter, thread restorations, thread gauges, thread files, tap and die set

Joining equipment

Manual Metal Arc (MMA), Metal Inert Gas (MIG) and oxy fuel welding equipment, riveting, pop rivets, chemical adhesives, specialist fasteners, locking devices

Cutting equipment, fasteners

Oxy/fuel cutting and heating, power hacksaw, band saw, cutting/ grinding discs

Finishes

Paint finish, oxides, ground coats, gloss and powder coating- plating/galvanise finish,
bare metal protection

Install replacement components

Tap and die selection, welding nozzle replacement, welding rod selection, hacksaw blade/band, selection replacement, speed and tension, grinding/cutting disc replacement, abrasive wheels regulations limitations.

Unit 322 Undertaking Specialist Land-based Workshop Practices

Outcome 3 Be able to carry out specialised maintenance and repair tasks

Assessment Criteria

The learner can:

1. Using **manufacturers' guidance** safely carry out specialised **maintenance and repair tasks** on given land-based equipment
2. Identify the need for specialised **maintenance and repair tasks** on given land-based equipment

Range

All learning disciplines: the range of specialist tools and equipment to measure and carry out critical settings on machines and equipment, typical to the area of study, which involve a higher level of technology, technical strategies or techniques

Unit content

Manufacturers' guidance

Routine maintenance charts, operator instruction manuals, service manuals, data sheets, spare parts selection from lists/manuals/electronic/websites, manufacturers suggested limitations, warranties, dealer involvement

Maintenance tasks

Routine/scheduled or non-scheduled, replacement service parts identification procurement and replacement, wearing components, effective working limits, replacement, upgrade of component from original

Repair tasks

Bearing identification, selection, safe removal, replacement, use of pullers, expansion and contraction methods, initial lubrication, alignments- belts and pulley removal replacement, tensioning, alignment, speed changes, effect on torque- chain and sprocket maintenance, removal, replacement, manual and automatic tensioning, speed change, effect on torque, lubrication and non lubrication situations, joining links, welding/remanufacture/replacement options

Unit 322 Undertaking Specialist Land-based Workshop Practices

Outcome 4 Understand the need for correct care and storage of specialised tools, equipment and materials.

Assessment Criteria

The learner can:

1. Explain the **care and storage** for selected specialist tools, equipment and materials
2. Discuss the importance of correct **care and storage** of selected specialist tools, equipment and materials.

Range

All learning disciplines: the range of specialist tools and equipment to measure and carry out critical settings on machines and equipment, typical to the area of study, which involve a higher level of technology, technical strategies or techniques

Unit content

Care and storage

Company procedures for authorised use, training/certification for use, records of use
Inspection of equipment, fit for purpose, calibration of measurement/readings
Careful handling, transit- maintenance of cutting/marking out tools cleaning sharpening pre storage, release of contained energy- return to storage, storage of materials, consumables – disposal of wastes, company policies, metals, waste lubricants, worn components, recycling, re-use

Unit 322 Undertaking Specialist Land-based Workshop Practice

Notes for guidance

This unit is designed to provide learners from all land based areas of study to expand on basic maintenance techniques. It is expected that the learner will have prior knowledge and experience in the use of basic hand tools and execution of basic maintenance and repair tasks. With the ever increasing technological advances in the design of land-based machines and equipment more in depth knowledge and understanding coupled with more complex service tools and strategies is becoming the norm for maintaining efficiencies and longevity of equipment. The reliance on dealer servicing and simple repairs can disrupt, greatly, the operating costs and production profits hence the need for operators to service and repair to higher technological levels.

In Outcome 1, the learner will be required to choose, describe and evaluate specialist tools available to carry out servicing and repair tasks. Where a choice of strategies or specialist tools are made available, justification for choice must be addressed. When justifying strategy, an insight into repair costings is needed. Removal by destruction may be far more effective than timely perseverance on low cost items.

In Outcome 2, the learner is expected to demonstrate safe and efficient use of specialist tools and equipment in given situations. The situations should be related to the learners' area of study. Where data sheets or manufacturers' in the safe and correct use of specialist tools and equipment are available these must be used. If tools are subject to wear inefficiency or precision calibration malfunctions, systems to restore accuracy must be carried out.

In Outcome 3, the learner must demonstrate, in conjunction with correct use of basic tools, the procedures of specialist tool use. Machine/equipment manufacturers' guidelines must be followed wherever possible. Emphasis must be on safe working practices and health and safety issues must feature at all times. To be successful in this unit the learner must demonstrate the understanding and need for specialised maintenance on land-based machines and equipment.

In Outcome 4**,** the learner must be able to explain the procedures to be carried out to specialist tools and equipment prior to a return to storage and the reasons why this must be done. Where company reporting procedures have been put in place regarding losses, damage, reduced performance of specialist tools, this must be addressed as required.

Centres are encouraged to introduce employers and specific professionals from industry to provide interesting and relevant information to the learner. Teaching would also benefit from visits to a variety of establishments to add depth to the learner experience.

References

Books

Bell, B. 1992. *Farm Workshop*. 2nd ed. Ipswich: Farming Press. ISBN 0852362374

Pearce, A. 2007. *Farm and Workshop Welding*. 2nd ed. Ipswich: Old Pond Publishing. ISBN 1905523300.

Website

Unit 323 Manage Agricultural Environments

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of agriculture and the environment and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

This unit aims to develop learners' understanding of the relationship between farming practices and the environment, and how this can be managed.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand the impact of different farming practices on the environment
2. Know significant environmental legislation and codes of practice
3. Be able to create a habitat management plan
4. Be able to complete practical habitat management tasks

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

Ga15 Contribute to the management of game habitat

Cu88 Manage habitats

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 323 Manage Agricultural Environments

Outcome 1 Understand the impact of different farming practices on the environment

Assessment Criteria

The learner can:

1. Evaluate the ways in which **conventional farming practices** have a positive and negative **environmental impact**
2. Evaluate the ways in which **sustainable farming practices** have a positive and negative **environmental impact**
3. Discuss ways in which the **negative environmental impact** of farming practices **can be reduced**.

Unit content

Conventional farming practices

History of farming practices, landscapes and land management, suitable selection for example crop and livestock enterprises using routine and preventative treatments

Sustainable farming practices

Those aiming to reduce the environmental impact, for example organic, permaculture, biodynamic farming

Environmental impact

Visual, noise, physical (for example waste, pollution control, impact on topography), consumption of raw materials and energy, impact on plant and animal species, immediate and long term impact

Reduction of negative environmental impact

Energy consumption, pollution, use of resources, use of chemicals and medicines

Unit 323 Manage Agricultural Environments

Outcome 2 Know significant environmental legislation and codes of practice

Assessment Criteria

The learner can:

1. Describe the impact of current **environmental legislation and codes of practice** on farming activities
2. Outline the role of given **environmental organisations** within the agriculture industry.

Unit content

Environmental legislation and codes of practice

Wildlife and Countryside Act 1981 (as amended), Environmental Protection Act 1990, Cross Compliance Nitrates Directive 1991, Hedgerows Regulations 1997, Control of Substances Hazardous to Health (COSHH) Regulations 2002, Water Framework Directive 2003, Waste Management (England and Wales) Regulations 2006, Environmental Impact Assessment (Agriculture) (England) Regulations 2006, Heather and Grass Burning Regulations and Code 2007)

Environmental organisations

Department for Environment, Food and Rural Affairs (Defra), Welsh Assembly Government (WAG), Scottish Executive Environment and Rural Affairs Department (SEERAD), Department of Agriculture and Rural Affairs (Northern Ireland), (DARDNI),
Environment Agency, Non-Government Organisations (for example BTCV, Farming and Wildlife Advisory Group (FWAG), Linking the Environment and Farming (LEAF), Organic Farmers and Growers, Royal Society for the Protection of Birds (RSPB), Save our Songbirds, Soil Association, local Wildlife Trusts, Woodland Trust, Natural England, Farming and Countryside Education

Unit 323 Manage Agricultural Environments

Outcome 3 Be able to create a habitat management plan

Assessment Criteria

The learner can:

1. Select **habitat management methods** to meet given objectives
2. Create a **schedule** for habitat management work.

Unit content

Habitat management methods

Field surveys to provide base data
Removal of invasive plant species, removal or reduction of invasive trees, scrub clearance, pond restoration, tree planting, weeding
Farm Environmental Plans under Higher Level Stewardship
Management of grassland/field margins and other farm habitats

Schedule

Order of activities, resources required, time required for each activity, cost, monitoring, record keeping, identification of barriers to progress and contingencies

Unit 323 Manage Agricultural Environments

Outcome 4 Be able to complete practical habitat management tasks

Assessment Criteria

The learner can:

1. Undertake appropriate **risk assessment** prior to undertaking selected practical habitat management work
2. Specify and organise **PPE, equipment and materials** required for undertaking selected practical habitat management work
3. Safely undertake practical **habitat management tasks** to meet given objectives

Unit content

Risk assessment

Undertake a risk assessment: assessment of risks, likelihood of occurrence, potential severity, ways of mitigating risks, for self and others involved in work activities

PPE

Overalls, safety boots, gloves, face mask, safety goggles, protective head gear

Equipment

Machinery, hand tools, horticultural tools

Materials

Wood, stakes, seedlings

Habitat management tasks

Field surveys to provide base data, to meet objectives, could include pond and ditch clearance, tree planting, coppicing, hedge laying, pollarding, mowing, brush cutting, removing unwanted plants or trees, weeding, mulching, clearing litter or debris

Unit 323 Manage Agricultural Environments

Notes for guidance

This unit aims to provide learners with an understanding of the impact that agricultural practices have on the environment, as well as the impact that the regulatory environment has on agricultural practices. It also provides learners with an opportunity to develop some practical skills in planning and implementing habitat management tasks.

As learners will be engaged in practical activity there should be an emphasis on safe working practices, including the use of appropriate Personal Protective Equipment (PPE), and appropriate risk assessments should be undertaken. At Level 3 it is expected that learners will take an active part in completing risk assessments, so that this becomes an integral part of all practical activity.

Delivery of this unit will involve practical tasks, visits to suitable habitats, and visits to farms operating conventional and sustainable farming practices.

Learners should have the opportunity to undertake habitat management in an agricultural setting wherever possible to maximise the vocational relevance.

In Outcome 1, learners will investigate the different practices involved in conventional and sustainable farming systems, and will compare the positive and negative environmental impacts of both. It is anticipated that some classroom delivery will be required to help learners to understand the potential environmental impacts, and visits to different types of farming enterprise will be helpful. Guest speakers would also add relevance and interest.

In Outcome 2, learners need to gain an overview of the significant legislation, and its impact on farming practices. Delivery will also need to enable learners to understand the requirement for those involved in farming to keep abreast of legislation, and the potential financial consequences. Learners also need to gain an oversight of the roles played by a range of environmental organisations. It is anticipated that this Outcome will be delivered through formal classroom activity, discussions and learner research. It may also be enhanced by a talk by a representative from an environmental organisation, or a visit, e.g. to an RSPB wildlife reserve.

For Outcomes 3 and 4 the focus is on practical habitat management, which should ideally take place in an agricultural context. Classroom delivery is likely to be required to help learners appreciate the type of habitat management objectives that may be set, and how these will impact on the habitat tasks completed. It is anticipated that significant practical delivery will be required to enable learners to become confident in their approach to habitat management tasks, and complete them safely and effectively. A particular emphasis on health and safety is required for these Outcomes. These Outcomes could also be developed in conjunction with learners' work experience at an appropriate placement.

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www.environment-agency.org.uk	Environment Agency
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www.fwag.org.uk	Farming and Wildlife Advisory Group
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www.woodland-trust.org.uk	The Woodland Trust

Unit 324 Undertake Dairy Production

Level: 3

Credit value: 10

Unit aim

This unit aims to introduce learners to the skills and knowledge in dairy production and how these can be applied in practice. This unit is designed for learners in centre-based settings looking to progress into the sector or into further/higher education.

The aim of this unit is to allow learners to develop and understanding of the principles of dairy herd management. The practical application of this knowledge is covered, with an emphasis on animal health and welfare in relation to clean milk production.

Learning outcomes

There are **four** learning outcomes to this unit. The learners will:

1. Understand the principles of rearing dairy herd replacements
2. Know how to manage cows through the production cycle
3. Be able to select replacements and manage dairy cow reproduction
4. Be able to apply hygiene regulations and legislation to clean milk production

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

LP28 Establish pregnancy and maintain livestock during gestation

LP35 Prepare, monitor and maintain the milking of livestock by machine

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 324 Undertake Dairy Production

Outcome 1 Understand the principles of rearing dairy herd replacements

Assessment Criteria

The learner can:

1. Discuss the **husbandry and health care requirements** of the newborn calf
2. Discuss the **rearing and management requirements** of a herd of heifers

Unit content

Husbandry and health care requirements

Housing, husbandry requirements, milk and feed requirements, rearing and feeding systems, importance and timing of colostrum intake, husbandry tasks (for example reasons for and methods of supernumerary teat reduction, disbudding), weaning, function and closure of oesophageal groove, introduction of hay and concentrates to encourage rumen development, disease prevention

Rearing and management requirements

Rearing and feeding systems, management at grass, herd replacement policy, planned timing of conception, choice of bull (for example for ease of calving), use of natural service or artificial insemination, condition scoring, target weights, target growth rates

Unit 324 Undertake Dairy Production

Outcome 2 Know how to manage cows through the production cycle

Assessment Criteria

The learner can:

1. Describe the **management of cows** during each phase of the production cycle
2. Identify the **feeding requirements** of cows through the production cycle
3. Describe the **management of disease** in cows through the production cycle

Range

Production cycle

Cycle from one calving to the next: calving, early lactation, lactation curve, oestrus, service, mid and late lactation, drying off, calving.

Unit content

Management of cows

Management at each phase of the production cycle: housing, husbandry, routine stock tasks, use of condition scoring, importance of and methods for oestrus detection, use of natural service or artificial insemination, choice of bull, service timing and management, pregnancy detection, preparation for drying off, calving and weaning management.

Housing requirements: accommodation, stocking density, draught prevention, cubicle housing, bedding systems, safety implications of group housing, guidelines, for example “five freedoms”

Feeding requirements

Requirements for maintenance and production (milk production, growth, development of the unborn calf), feeding objectives at each stage of the cycle, selection of feeding regime (grass/forage, concentrates, feed to yield, flat rate feeding, complete diet feeding), appetite, use of condition scoring, relationship between diet and milk quality.

Management of disease

Management to prevent and treat disease: metabolic diseases (for example hypocalcaemia, hypomagnesaemia, fatty liver, ketosis, acidosis), bacterial, viral and fungal diseases, notifiable diseases (for example brucellosis, BSE, tuberculosis), displaced abomasums, foot problems, use of preventative measures (for example vaccination, control of internal and external parasites, foot trimming, diet management), requirement for veterinary assistance

Unit 324 Undertake Dairy Production

Outcome 3 Be able to select replacements and manage dairy cow reproduction

Assessment Criteria

The learner can:

1. Describe the **breeding cycle** in cows
2. Carry out **activities to manage reproduction** in dairy cows
3. **Select** replacements and breeding stock

Unit content

Breeding cycle

Events through the year, calving, early lactation, lactation curve, oestrus detection, service management, use of natural service or artificial insemination, mid and late lactation, drying off, calving interval definition and optimal length

Activities to manage reproduction

Examples include detection of oestrus, use of synchronisation and oestrus detection aids, service management, presentation for artificial insemination, presentation for pregnancy diagnosis, condition scoring

Select

Choose based on conformation, maternal milking performance, breed characteristics, condition, health, age and size, herd objectives, time of year born, herd calving pattern

Unit 324 Undertake Dairy Production

Outcome 4 Be able to apply hygiene regulations and legislation to clean milk production

Assessment Criteria

The learner can:

1. Carry out **activities to milk dairy cows**
2. Apply **hygiene procedures** to meet **regulations and legislation**
3. Describe the **symptoms**, **causes, prevention and treatment of mastitis** in dairy cows
4. Examine the requirements of **farm assurance** as applicable to dairy production

Unit content

Activities to milk dairy cows

Parlour preparation and set up, reasons for in and out of parlour feeding, udder washing and preparation, application of teat cups, removal of teat cups (for example by hand, automatic cluster removal), teat disinfection, cow entrance and exit from the parlour, parlour cleaning and shut down.

Hygiene procedures

Udder washing and drying, use of teat disinfectant, use of fore milking, avoidance of over milking, use of clean clothing, cleaning arms and forearms, reasons for use of gloves, parlour cleaning, discarding of milk from ill or antibiotic treated cows

Regulations and legislation

Current UK and EU regulations and legislation, for example Regulation (EC) 852/2004, 853/2004, 854/2004, Food Hygiene Regulations 2006

Symptoms, causes, prevention and treatment of mastitis

Types of mastitis (acute, sub acute, chronic), symptoms for each type (for example udder pain, swelling, fever, udder hardening, milk reduction, cow behaviour), causes: bacterial (for example *Streptococcus uberi, Staphylococcus aureus, Corynebacterium*), use of antibiotic treatment, prevention: design of accommodation, bedding and cleanliness, milk machine testing, cell count monitoring, use of parlour hygiene procedures, early diagnosis and treatment of affected cows.

Farm assurance

Requirements of farm assurance schemes (Assured Dairy Farms), hygiene and food safety, housing and facilities, plant and equipment, feeding stuffs and water, herd health, stockmanship and training, contingency procedures, environmental standards.

Unit 324 Undertake Dairy Production

Notes for guidance

This unit is designed to equip learners with a good understanding of dairy cow management, and to develop some practical husbandry skills. As learners will be engaged in practical activity there should be an emphasis on safe working practices, including the use of appropriate Personal Protective Equipment (PPE), and appropriate risk assessments should be undertaken. At Level 3 it is expected that learners will take an active part in completing risk assessments, so that this becomes an integral part of all practical activity. Learners should also be made aware of the importance of animal welfare, and sustainability concepts should also be demonstrated where possible.

For Outcome 1 delivery is likely to include a mix of theory and practical. Classroom based activity will be required to enable learners to gain an understanding of calf husbandry and health care requirements and heifer management. It is anticipated this will be supplemented by visits and the opportunity to take part in supervised practical activities.

For Outcome 2 learners need to gain an understanding of the production cycle, or dairy cow year, and the husbandry practices and tasks that are associated with each stage of lactation. Delivery will be most effective if learners are able to witness a range of feeding and management practices at the different stages of production. Learners will need to understand the different requirements for nutrition at different stages of lactation, and how the different feeding strategies link to both economics and enhancing productivity. Learners will also need to gain an understanding of the different types of disease, and particularly the importance of metabolic disease in the high performing dairy cow.

For Outcome 3 learners will need the opportunity to develop practical skills in dairy cow reproduction management through supervised farm practicals. This could be linked to an appropriate work placement. Learners will need to be able to detect oestrus, and recognise the importance of its detection and service timing. Learners will also need the opportunity to select replacements or breeding stock, and will need access to appropriate records as well as to the heifers or cows.

For Outcome 4 learners will need sufficient opportunity to develop their skills in practical milking procedures, including parlour set up and cleaning and the use of good hygiene procedures. It is anticipated there will also be some classroom based delivery to examine the requirements of the farm assurance scheme for dairy production, which could be enhanced by use of a guest speaker, either a representative from Assured Dairy Farms or a participating dairy farmer would add relevance and interest.

Centres are encouraged to introduce employers and specific professionals from industry to provide interesting and relevant information to the learner. Teaching would also benefit from visits to a variety of establishments to add depth to the learner experience.

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www.mdc.org.uk	DairyCo (formerly Milk Development Council)
www.milk.co.uk	Dairy Council
www.ndfas.org.uk	Assured Dairy Farms (formerly National Dairy Farm Assured Scheme)

Unit 325 Undertake Beef Production

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of beef production and how these can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

This unit aims to develop learners' skills in beef stock production and an understanding of how these can be applied in practice. Learners will develop their knowledge of different beef stock systems as well as good husbandry and management of beef stock. They will research the health and nutritional needs of beef stock. The unit is designed primarily for learners in a centre-based setting looking to progress into the sector or onto further education.

Learning outcomes

There are **four** learning outcomes to this unit. The learners will:

1. Know beef production systems used in the UK
2. Understand principles of suckler herd health and breeding
3. Be able to perform routine beef stock skills
4. Be able to complete and use beef management records

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

LP25 Promote and maintain the healthy performance of livestock
CU6 Maintain communications and records within the organisation
LP47 Assist in delivering basic treatments to livestock

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 325 Undertake Beef Production

Outcome 1 Know beef production systems used in the UK

Assessment Criteria

The learner can:

1. Identify **characteristics** of given beef breeds
2. Describe given **beef production systems**
3. Outline key **nutritional and health requirements** for given beef production systems

Unit content

Characteristics

Characteristics and examples of different breeds (British, continental), early maturing (e.g.Aberdeen Angus, Hereford), late maturing (e.g. Charolais, Simmental), cross breds from dairy production systems, size at maturity, growth rates, feed conversion ratio, handling and management considerations, carcass quality, growth differences between heifers, steers and bulls

Beef production systems

Type of system: cereal beef, maize silage beef, 18 month grass/cereal beef and 24 month grass/silage beef, grass finishing of store cattle
Features of system: growth rates, age at reaching finished weight, suitability of breed and sex for production system, cost, market requirements, housing and grassland requirements, stock handling requirements.

Nutritional and health requirements

Nutritional requirements for different systems, grassland management (18 and 24 month systems), stocking density, use of cereals, target liveweight gains, common health problems for each system and their prevention and treatment

Unit 325 Undertake Beef Production

Outcome 2 Understand principles of suckler herd health and breeding

Assessment Criteria

The learner can:

3. Explain the **production of a suckled calf**
4. Explain **factors** affecting suckler herd **performance**

Unit content

Production of a suckled calf

Suckler calf systems: single, double and multiple suckling, reasons for system choice (for example location, breed, grassland availability), factors affecting timing of calving and weaning, nutritional requirements through cycle, feeding and herd health, market requirements, target body condition score, service planning and management, advantages and disadvantages of autumn and spring born calves

Factors

Type of system, breed, use of purebreds or crossbreds, season of calving, grassland quality and management, health problems and their management (for example mastitis, diarrhoea, dehydration, cystic ovaries, internal and external parasites, lameness), feeding and condition, use of housing during winter, breeding management (for example choice of bull, oestrus detection, calving intervals, planned calving), sale of store or finished cattle

Performance

Gross margin (sales of calves and culls less variable costs, for example feed), daily liveweight gain, calf mortality rates, age and value at sale, herd replacement rates, calving spread, calving interval, stocking rates.

Unit 325 Undertake Beef Production

Outcome 3 Be able to perform routine beef stock skills

Assessment Criteria

The learner can:

1. Complete **risk assessment** relevant to routine beef stock procedures
2. Carry out **routine beef stock procedures** to meet given objectives

Unit content

Risk assessment

Identify risks, assess for likelihood and impact, determine actions to minimise risk, for example use of Personal Protective Equipment (PPE), briefing of others involved, use of correct equipment and procedures, checking equipment before task, correct restraint for livestock

Routine beef stock procedures

Examples include restraint and handling methods (for example use of race, halter, cattle crush), weighing, treatment of internal and external parasites, vaccinating, foot trimming, branding, ear tagging, clipping out, castration, feeding and grazing management, movement, selection of animals (for example stores for purchase, beef animal for slaughter), condition scoring

Unit 325 Undertake Beef Production

Outcome 4 Be able to complete and use beef management records

Assessment Criteria

The learner can:

1. Collect and use **beef management data**
2. Complete **beef management records** in compliance with relevant **legislative requirements**

Unit content

Beef management data

Daily liveweight gain, food consumed, food conversion ratio, days to finishing, finishing weight, age and sale price per kg, purchase price (if applicable) variable costs (for example feed costs, vet and medicine costs), gross margin calculation and comparison with targets and standards

Beef management records

Herd register (ear tag number, date of birth, sex, breed, dam details), movement records (date of movement on or off premises and movement details), date of cattle deaths, timescales for completion, application for cattle passports, veterinary medicines book completion, use of computerised and online records

Legislative requirements

Requirements of legislation and codes of practice, for example The Cattle Identification Regulations 2007, Welfare of Farmed Animals Regulations 2000, Welfare of Animals (Transport) Order 2006, Defra Welfare of Cattle code of recommendations 2003, Veterinary Medicines Directive Code of Practice on the responsible use of animal medicines on the farm.

Unit 325 Undertake Beef Production

Notes for guidance

This unit is designed to provide learners with an understanding of the main types of beef production system in the UK, and to equip them with some practical husbandry skills. As learners will be engaged in practical activity there should be an emphasis on safe working practices, including the use of appropriate personal protective equipment Personal Protective Equipment (PPE), and appropriate risk assessments should be undertaken. At Level 3 it is expected that learners will take an active part in completing risk assessments, so that this becomes an integral part of all practical activity. Learners should also be made aware of the importance of animal welfare, and sustainability concepts should also be demonstrated where possible.

For Outcome 1 delivery is likely to include a mix of theory and practical. Classroom based activity will be required to enable learners to gain an overview of beef breeds, their different characteristics and the systems which are most suited to different breed types. It would be helpful for learners to visit a range of beef production systems, and to witness different breed types. A visit to a local county agricultural show to see the cattle lines and showing classes would present an ideal opportunity for this.

For Outcome 2 learners need to gain an understanding of suckler cow enterprises, and how these may differ in different UK locations. For example a hill single suckled system selling stores compared with a lowland double suckled system taking stock through to slaughter. Delivery is likely to include a mix of classroom activity and visits, but may also include audio visual material to highlight systems in other UK regions.

For Outcome 3 learners will need to have the opportunity to develop practical husbandry skills in a supervised beef enterprise setting. This could be linked to an appropriate work placement. It is important that health and safety of the learner, and welfare of the animal, are emphasised in both theory and practice. It is expected that learners will gain an overview of the husbandry tasks and requirements, and will gain practical skills in at least three tasks.

For Outcome 4 learners will need access to a range of beef management data, and delivery will need to encompass use and analysis, and comparison with local and national performance standards. Where data is sensitive in nature, for example financial data, collected data may be supplemented with realistic case study material. It will be acceptable for learners to complete simulated records where it is not appropriate or feasible to complete them first hand. Learners will be required to have an overview of key current legislation and the requirements for beef farmers to comply with this, which may be supplemented by a guest speaker discussing how legislation affects their husbandry practices.

Centres are encouraged to introduce employers and specific professionals from industry to provide interesting and relevant information to the learner. Teaching would also benefit from visits to a variety of establishments to add depth to the learner experience.

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www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.fawc.org.uk	Farm Animal Welfare Council
www.mlc.org.uk	Meat and Livestock Commission
www.rpa.gov.uk	Rural Payments Agency
www.vmd.gov.uk	Veterinary Medicines Directorate

Unit 326 Undertaking Pig Production

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of pig production and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or onto further/higher education.

The aim of this unit is to develop learners understanding of pig production systems coupled with the husbandry and managerial skills needed to work in the pig sector.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand the major pig production systems
2. Understand the management of the breeding pig
3. Understand the management of the growing pig
4. Be able to perform relevant pig husbandry techniques

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

LP25.1 Deliver basic treatments to livestock

LP28.1 Establish, implement and evaluate a herd breeding plan

LP24 Establish, monitor and maintain appropriate conditions for livestock

LP27 Maintain, monitor and evaluate the provision of feed and water to livestock

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 326 Undertaking Pig Production

Outcome 1 Understand the major pig production systems

Assessment Criteria

The learner can:

1. Compare the major **pig production systems** including intensive and extensive
2. Review the factors that determine the choice of each system including
   - **accommodation**
   - **location**
   - **markets**
   - **environmental**
   - **resources**.

Unit content

Pig production systems

Indoor systems, including straw based, slatted, types of housing, outdoor systems, space requirements, layouts and arcs, purpose of systems (for example breeding unit, weaner production, fattener units), waste disposal, productivity

Accommodation

Land availability and soil type, pig housing availability, suitability of pig housing, construction materials, ventilation, heating, lighting, dimensions, stocking density

Location

Weather, exposure, accessibility, topography, proximity to markets, transport routes

Markets

Opportunity for niche market, availability of buyers, supply requirements

Environmental

Waste management systems, proximity to population dwellings, proximity to water courses, impact of environmental legislation (Environmental Protection Act 1990, Waste Management (England and Wales) Regulations 2006, Environmental Impact Assessment (Agriculture) (England) Regulations 2006)

Resources

Investment capital, labour, feedstuffs, machinery

Unit 326 Undertaking Pig Production

Outcome 2 Understand the management of the breeding pig

Assessment Criteria

The learner can:

1. Explain the **husbandry** of breeding pigs
2. Discuss **common problems** associated with breeding pigs
3. Evaluate **factors** which determine sow **productivity (SM3)**

Range

Breeding pigs – sows and boars kept for breeding purposes

Unit content

Husbandry

Nutrition and feeding, feed types, frequency of feeding, ration formulation, health checks, preventative care, maintaining health, cleaning accommodation, accommodation maintenance, service management, pregnancy diagnosis, gilt management, care based on "five animal needs"

Common problems

Sow condition after weaning, infertility, boar performance, farrowing problems, age, other general health problems

Factors

Breed, age, condition, service management (including heat detection, timings of service, frequency, use of boar or artificial insemination)

Productivity (SM3)

Number of litters born per year, number of live piglets born per litter, number of piglets born per litter

Unit 326 Undertaking Pig Production

Outcome 3 Understand the management of the growing pig

Assessment Criteria

The learner can:

1. Explain the **husbandry** of the growing pig
2. Discuss **common problems** associated with growing pigs
3. Evaluate the **factors** which influence the growth of pigs including
    - **accommodation**
    - **location**
    - **markets**
    - **environmental**
    - **resources**.

Range

Growing pig: pigs being kept for meat production, from piglet to finishing

Unit content

Husbandry

Nutrition and feeding, feed types, frequency of feeding, ration formulation, health checks, preventative care, maintaining health (for example iron injections, observing for signs of disease and treating accordingly), housing, care at different life stages, movement, routine stock care tasks (for example teeth clipping, weighing), care based on "five animal freedoms"

Common problems

Piglet mortality, disease, behaviour problems (e.g. tail biting, aggression), growth rate problems

Factors

Breed, feeding regime, housing, health, welfare, management

Unit 326 Undertaking Pig Production

Outcome 4 Be able to perform relevant pig husbandry techniques

Assessment Criteria

The learner can:

1. Carry out **routine care** and associated **stock tasks** according to **codes of practice and legislation**
2. Plan a **layout** for a pig unit from given information
3. Analyse selected **physical and financial records** to assess performance of a pig herd.

Range

Pig tasks: routine tasks for breeding and growing pigs

Unit content

Routine care

Feeding, watering, waste disposal, movement, record keeping (e.g. of medication, feed, date of movement, service dates, farrowing data)

Stock tasks

Teeth clipping, tail docking, injecting, weighing, moving, handling

Codes of practice and legislation

Relevant legislation and codes of practice e.g. Health and Safety at Work etc Act 1974, Farm Animal Welfare Council Five Freedoms (or "animal needs"), Welfare of Farmed Animals Regulations 2000, Veterinary Medicines Regulations, Defra Code of Recommendations for the Welfare of Animals: Pigs 2005, Defra Animal Health and Welfare Framework 2009

Layout

Pig housing for different age groupings, boar pens, service area, location of feed bins, waste disposal systems, isolation pens, access for transport

Physical and financial records

Physical records: growth rates, sow productivity, food conversion ratio, financial records: gross margin information

Unit 326 Undertaking Pig Production

Notes for guidance

This unit aims to provide learners with an understanding of pig production, including a study of the different pig production systems in operation. It also provides learners with an opportunity to develop some practical skills in routine care and stock tasks for pigs.

As learners will be engaged in practical activity there should be an emphasis on safe working practices, including the use of appropriate Personal Protective Equipment (PPE), and appropriate risk assessments should be undertaken. At Level 3 it is expected that learners will take an active part in completing risk assessments, so that this becomes an integral part of all practical activity.

Delivery of this unit will include practical tasks and visits to pig units housing growing and breeding pigs in extensive and intensive systems. Learners would also benefit from time spent at an appropriate work placement.

Outcome 1 enables learners to gain an overview of pig production systems of different types. Visits to different pig units will be helpful, as will discussion with those currently managing a unit. It will be particularly useful for learners to gain a clear understanding of the soil, climate and topography requirements of an outdoor unit, which may be through first hand experience or appropriate class based activity and research.

Outcome 2 covers the husbandry and management of the breeding pig. It is anticipated that a range of delivery techniques will be used, including practical demonstrations, lectures, supervised pig handling practical sessions and appropriate farm visits.

Outcome 3 focuses on the husbandry and management of the growing pig. It is expected that delivery will cover husbandry and management at the different growth stages, i.e. piglet, weaner, grower and finishing pig. Delivery should include the opportunity to practise a range of husbandry tasks as well as more formal input.

For Outcome 4 the learner will develop understanding, knowledge and skills relating to the practicalities of pig unit management. This includes practical stock tasks, and sufficient delivery time is required to ensure learners develop appropriate confidence and ability. A range of stock tasks and routine care duties should be practised, including those required for adult and younger pigs.

Learners are also asked to plan a basic layout for a pig unit based on information supplied by the tutor, and to analyse physical and financial records. Where live records are not available, realistic case study material should be used. Analysis should be carried out relative to appropriate industry standards. A particular emphasis on health and safety is required for this outcome, which could also be developed in conjunction with learners' work experience at an appropriate placement.

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Unit 327 Undertaking Poultry Production

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of poultry production and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or onto further/higher education.

Upon completion of this unit the learner will have developed skills and knowledge of monitoring and caring for poultry in different systems of production.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know the requirements of the main commercial poultry systems
2. Understand husbandry requirements for different systems of poultry production
3. Be able to deliver routine husbandry procedures
4. Understand production performance

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

CU7.2 Maintain and store records within the workplace
LP16 Prepare birds for reproduction and enable fertilisation
LP17 Brood and grow young birds
LP18 Receive and select eggs for hatching
LP20 Prepare, load and incubate hatching eggs
LP21 Hatch and dispatch poultry
LP22 Establish and maintain egg production
LP24 Establish, monitor and maintain appropriate conditions for livestock
LP25.1 Deliver basic treatments to livestock
LP25.2 Deliver routine husbandry procedures
LP27 Maintain, monitor and evaluate provision of feed and water to livestock

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 327 Undertaking Poultry Production

Outcome 1 Know the requirements of the main commercial poultry systems

Assessment Criteria

The learner can:

1. Identify the major **commercial poultry systems**
2. Outline the **factors** that determine the choice of each system
3. Describe different **accommodation requirements** for the major commercial poultry systems

Range

Chickens, turkeys, ducks, geese (learners need to cover at least one species)

Unit content

Commercial poultry systems

Intensive/cages, barns, deep litter, semi intensive, extensive/ free range, mobile arks

Factors

Housing, feeding, disease control, predators, costs, labour, welfare, resource and capital availability, market influence

Accommodation requirements

Stocking density, protection/shelter, ventilation, feed and water, temperature, lighting, litter, cleaning requirements, egg handling systems, current relevant legislation and restrictions

Unit 327 Undertaking Poultry Production

Outcome 2 Understand husbandry requirements for different systems of poultry production

Assessment Criteria

The learner can:

1. Explain different **husbandry** requirements for different systems of production
2. Examine the **husbandry** required for a given system
3. Discuss **common problems** associated with poultry in production systems

Range

Chickens, turkeys, ducks, geese (learners need to cover at least one species)

Commercial poultry systems

Intensive/cages, barns, deep litter, semi intensive, extensive/ free range, mobile arks

Unit content

Husbandry

Codes of practice, “five animal needs”, inspection, lighting, basic litter management, feeding and watering methods, health care and checking, manual /automatic systems

Common problems

Disease/illness, competition between birds, cannibalism, feather pecking, injury, poor production, access to feed and water, stress, poor design, vermin

Unit 327 Undertaking Poultry Production

Outcome 3 Be able to deliver routine husbandry procedures

Assessment Criteria

The learner can:

1. Carry out associated **stock tasks**
2. **Prepare accommodation** for a given **class** of poultry
3. Carry out **routine care** of stock
4. Maintain correct **environmental conditions** for given systems

Range

Chickens, turkeys, ducks, geese (learners need to cover at least one species)

Unit content

Stock tasks

Inspection, health checking, basic litter management, providing food and water

Prepare accommodation

Assessing, setting or adjusting ventilation, temperature and lighting, cleaning and replenishing bedding, preparation of feeders and drinkers, establishment of bio security, keeping records

Class

Broilers, breeders, commercial layers, turkey breeders, turkey growers, duck breeders, growing ducklings, geese

Routine care

Feeding, watering, basic litter management, health checking, controlling the environment, waste disposal, culling, inspection, recording

Environmental conditions

Ventilation, temperature, lighting

Unit 327 Undertaking Poultry Production

Outcome 4 Understand production performance

Assessment Criteria

The learner can:

1. **Measure** and record the performance of a given system
2. Analyse selected physical and financial records to assess **performance** of a poultry system

Range

Chickens, turkeys, ducks, geese (learners need to cover at least one species)

Unit Content

Measure

Count and calculate egg production, record feed consumption, calculate liveweight gain and food conversion ratio, record sales prices (eggs, table birds)

Performance

Bodyweight, variation, egg numbers, egg weight,, egg mass, egg quality, mortality, food conversion rate (FCR), fertility, hatchability, bird housed, bird day, mortality, financial, gross margin, housing costs, labour costs, compared with national averages

Records to assess performance

Computerised, manual, graphs and charts, legal requirements

Unit 327 Undertaking Poultry Production

Notes for guidance

Upon completion of this unit, the learner will have developed skills and knowledge of monitoring and caring for poultry in different systems of production.

The delivery of this unit should use as wide a range of techniques as possible including lectures, discussions, seminar presentations, supervised poultry practicals, site visits, work placements, internet and/or library–based research as suitable.

Outcome 1 requires the learner to know the different methods used for commercial production of both egg laying production and meat production systems. The unit is likely to be delivered through formal lectures, supervised practical sessions, farm visits and directed study. Learners will be required to cover all types of systems for at least one species of poultry.

Outcome 2 requires the learner to understand the husbandry requirements for different systems of poultry production. Delivery will be mainly through formal lectures and guided study although visits to different commercial poultry production establishments would enhance delivery.

Outcome 3 requires the learner to carry out practical routine poultry husbandry procedures. The outcome is very practical and learners should have the opportunities to carry out such tasks in a supervised environment reflective of a commercial environment. Assessment will be based on the completion of tasks in a realistic work environment which reflects the pressures and constraints of those found in the commercial environment.

Outcome 4 requires the learner to understand production performance. Learners will have gained practical experience during work experience in a commercial environment to enable them to understand the importance of accurate measuring, recording, and analysis of such records. Delivery of the outcome will need to include understanding of how to interpret data and the impact that this has on the commercial poultry production environment and profitability.

Delivery of this unit could be enhanced by the use of case studies and talks from outside speakers from commercial poultry farmers. It is important that any practical sessions are assessed in line with commercial requirements, pressures and constraints, Health and Safety and current legislation and welfare guidelines. The welfare of the animals is paramount and must be regularly reinforced and the correct techniques and the confidence of the learner ensured prior to assessment (wherever possible) in an environment reflective of the Commercial Poultry Sector. Tutors and learners should comply with bio-security requirements of any farms being visited. The tutor should be mindful, particularly in intensive poultry production, management of the controlled environment is critical.

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Unit 328 Undertaking Sheep Production

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of sheep production and how these can be applied in practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or onto further/ education.

This unit enables learners to relate sheep husbandry and management skills to flock management. It also applies information on nutrition, welfare and marketing in a practical situation.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand common sheep production and marketing systems
2. Understand sheep production
3. Be able to care for a breeding sheep flock from pre lambing through to summer grazing
4. Be able to maintain the health and wellbeing of a sheep flock

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

LP25.2 Deliver routine husbandry procedures

LP28.1 Establish, implement and evaluate a herd breeding plan

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 328 Undertaking Sheep Production

Outcome 1 Understand common sheep production and marketing systems

Assessment Criteria

The learner can:

1. Explain the **stratification system** of the UK sheep industry in terms of local **breeds** and production systems
2. Compare the **main sheep breeds** and their **suitability for different production systems**
3. Describe **market requirements** and **marketing opportunities** for common sheep production systems

Unit content

Stratification system

Definition of stratification system, interdependence of cross-breeding programme, sale of draft ewes from hills to uplands, sale of crossbred lambs to lowlands for finishing, cross breeding and hybrid vigour

Main sheep breeds

Hill breeds (for example Scottish Blackface, Swaledale, Welsh Mountain), Upland breeds (for example Clun, North Country), Longwools (for example Blue-faced Leicester, Border Leicester), Lowland breeds (for example Suffolk, Texel, Hampshire Down), Crossbreeds (for example Mule, Masham, Scottish Halfbred)

Suitability for different production systems

Hardiness, milking and mothering ability, fertility, growth rate, carcass quality

Market requirements

Market criteria: for weight, conformation and breed type, age

Marketing opportunities

Marketing options for finished lambs, store lambs, breeding stock, draft ewes, ewes for crossing with terminal sire breeds, pedigree breeding stock, timing of sales and impact on price and marketability, carcass classification

Unit 328 Undertaking Sheep Production

Outcome 2 Understand sheep production

Assessment Criteria

The learner can:

1. Assess the **suitability of stock for breeding**
2. Explain how to **prepare a flock for breeding**
3. Explain the **control/prevention** of **common sheep diseases and disorders**

Unit content

Suitability of stock for breeding

Breeding stock selection, breed, conformation, age, health, suitability, records

Prepare a flock for breeding

Preparation of ewes and rams for breeding, condition scoring, checking ewes' teeth, feet and udders, checking rams, use of selection programmes in flock improvement, breeding programmes, planning ram to ewe ratio, use of teaser rams, use of raddle, importance of timing for raddle changes

Control and prevention

Management factors, treatment programmes, administration of treatments, completing medicine records, construction of a health plan for the flock, disposal of waste, safe storage of medicines

Common sheep diseases and disorders

Twin lamb disease, lameness, strike, internal and external parasites, respiratory infections, clostridial diseases, seasonality

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Unit 328 Undertaking Sheep Production

Outcome 3 Be able to care for a breeding sheep flock from pre lambing through to summer grazing

Assessment Criteria

The learner can:

1. Plan the **nutrition of the flock** at the various **stages of the cycle (pre tupping, tupping, mid and late pregnancy, lambing, lactation)**
2. **Care for rams, ewes, and new born lambs**
3. Plan **grassland management** for a flock of ewes and lambs

Unit content

Nutrition of the flock

Evaluate types and utilisation of feeds, feeding programme, plan feeding for a flock of in-lamb ewes

Stages of the cycle

Pre-tupping, tupping, mid and late pregnancy, lambing, lactation

Care for rams, ewes and new born lambs

Preparations for pre-lambing and lambing:
Scanning, methods of preventing abortion and dealing with aborting ewes, identification of ewes that need assistance, assisting with lambing, importance of the ewe/lamb bond, identification of ewes with metabolic problems, methods of prevention

Care for rams
Management outside of breeding season (nutrition, handling, routine health and husbandry treatments e.g. foot trimming, vaccination, shearing), care in preparation for breeding season (breeding soundness checks, condition scoring, foot trimming, worming)

Care of the newborn lamb:
Importance of adequate colostrum, navel treatments, tail docking, methods of castrating lambs, feeding lambs using a stomach tube, common problems, disease prevention in lambs during the first few weeks of life, methods of preventing abortion, dealing with aborting ewes, causes of and prevention of hypothermia in newborn lambs, taking the temperature of lambs, fostering lambs, record keeping

Grassland management

Requirements for conservation and grazing, matching grass growth curve to flock demands, requirements for conserved winter forage and method of providing it, managing grazing areas throughout the grazing season.

Unit 328 Undertaking Sheep Production

Outcome 4 Be able to maintain the health and wellbeing of a sheep flock

Assessment Criteria

The learner can:

1. Carry out **routine procedures** on ewes, rams and lambs.
2. Keep **records**
3. **Select stock for market**
4. Identify the **symptoms of the main sheep diseases/disorders**.

Unit content

Routine procedures

Checking and trimming feet, treating lameness, dagging ewes and lambs, ear tagging ewes or lambs, administering treatments for internal and external parasites, vaccinating sheep, the role of veterinary medicines in treating and controlling disease,

Records

Legally required records, medicine records, flock records, movement records, nutrient application records, management records, performance records, calculation of performance indicators

Select stock for market

Select finished lambs on weight, fat cover, conformation and target market, select store lambs based on weight conformation and target market, select ewes and rams for sale based on breeding potential, conformation and performance records

Symptoms of main sheep diseases/disorders

Signs of health, symptoms of major sheep diseases: twin lamb disease, lameness, strike, internal and external parasites, respiratory infections, entropion, clostridial diseases, frothy mouth, seasonality

Unit 328 Undertaking Sheep Production

Notes for guidance

This unit is designed to provide the learner with sound knowledge and skills required to manage a sheep enterprise. This unit gives tutor's scope to focus on sheep management systems found in the locality.

Throughout the unit, the emphasis should be on health and safety. It is expected that learners will be aware of safe working practices and environmental issues and be familiar with accepted practices and behaviours within the context in which they are working. Potential risks are minimised by considering relevant health and safety issues and welfare codes of practice when undertaking practical and managerial tasks.

In Outcome 1 the learner will be required to consider the types of sheep flock found on farms in the British Isles, and see how stratified breeding systems have been used. They will be involved in comparing breeds and breed crosses, their role in the local industry, and the role each breed/breed cross has in meeting market requirements. It will be important for learners to understand the climate and other environmental factors that have contributed to the evolution of the interdependent system of sales and cross breeding between hills, upland and lowland sheep flocks. As most learners will only have the opportunity to visit one type of production system in their locality, it would be helpful if delivery could be supplemented by DVD and video footage of alternative UK systems.

Outcome 2 covers the selection of breeding stock and how a flock is prepared for breeding. This entails considering the managerial activities that are involved in preparing a flock for tupping and practicing the skills associated with these activities.

In Outcome 3 learners will look at the nutrition of the flock throughout the year, the role of grass in flock nutrition and the role of supplements at times of peak demand. This will entail investigating the nutritional content of common feedstuffs and how these can be used to meet the needs of ewes and lambs. Learners will also be involved in caring for ewes and lambs at lambing time.

Outcome 4 has a practical emphasis and covers the routine procedures carried out on ewes, rams and lambs, record keeping, selecting stock for market and disease identification. Also included is the essential consideration of the relevant health and safety issues, welfare codes of practice together with environmental issues in order to minimise potential risks.

Learners working towards Level 3 are likely to have some experience of sheep husbandry. This unit aims to develop the learner's knowledge and skills in flock husbandry and management. Learners will follow the production cycle from pre tupping, through lambing to weaning and sale of lambs. Emphasis needs to be placed not only on 'doing` but also in the importance of being involved in managerial decisions. It is also important that the learner understands current legislation and Codes of Practice in relation to animal health and welfare, health and safety and transport of livestock.

Centres are encouraged to introduce employers and specific professionals from industry to provide interesting and relevant information to the learner. It is accepted that formal lectures will be necessary at Level 3, but for this unit it is recommended that they are linked directly with interactive lessons in the working environment. Learners must be given the opportunity to see and work with a range of types of sheep flock which reflects current industry practice in the locality.

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Unit 329 Mechanised Agricultural Crop Handling and Storage

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of mechanised agricultural crop handling and storage and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

The learner will develop their knowledge and understanding of the efficient handling, conditioning, storage and grading of a range of agricultural crops.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know the systems used to maintain combinable crop seeds in store
2. Know the processes and systems to maintain harvested root crops in store
3. Understand the processes and systems to maintain soft fruit, field vegetable or forage crops in store
4. Be able to use machinery and equipment used for handling, cleaning, grading and weighing crops

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

AgC12.1 Maintain and control harvesting operations

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 329 Mechanised Agricultural Crop Handling and Storage

Outcome 1 Know the systems used to maintain combinable crop seeds in store

Assessment Criteria

The learner can:

1. Outline **combinable crop drying and storage systems**
2. Describe the factors that define **appropriate storage conditions** for combinable crops
3. Describe how **storage systems/dryer designs** are influenced by the **quality requirements** of combinable crops in storage

Range

Combinable crops: wheat, barley, oats, beans, peas, oilseed rape

Unit content

Combinable crop drying and storage systems

Permanent, portable direct heating systems, continuous flow, batch, ventilated bin and on-floor dryers, on-floor and ventilated bins

Appropriate storage conditions

Cleanliness: dust, mildew, contaminant (oil, grease, spillage) free, moisture content into store and market requirements, pest control (rodents, insects, birds), in store movement

Storage systems/dryer designs

Dryer capacity, continuous air flow capacity, volume to be stored, end use of crop (seed, feed, malt, industrial), cost

Quality requirements

Moisture content, cleanliness, lack of contamination, nutrient content

Unit 329 Mechanised Agricultural Crop Handling and Storage

Outcome 2 Know the processes and systems to maintain harvested root crops in store

Assessment Criteria

The learner can:

1. Outline **root crop storage systems**
2. Describe the factors that define **appropriate storage conditions** for root crops
3. Describe the criteria used to select **appropriate storage methods** for root crops

Range

Root crops: potatoes, carrots, parsnips, onions, beet

Unit content

Root crop storage systems

In field clamps, indoor storage: (unitised, ventilated, chilled)

Appropriate storage conditions

Cleanliness, moisture content, temperature, air movement, use of chemicals, length of storage time, future use of stored crop, local climate, quantity of crop to be stored, costs

Unit 329 Mechanised Agricultural Crop Handling and Storage

Outcome 3 Understand processes and systems to maintain soft fruit, field vegetable or forage crops in store

Assessment Criteria

The learner can:

1. Explain the **processes** involved in the **storage** of **selected field scale vegetables, soft fruit or forage crops**
2. Discuss **control of the deterioration** of **field scale vegetables, soft fruit or forage crops in store**

Range

Soft fruit to include strawberries and raspberries
Vegetables to include lettuce, cabbage, cauliflower, broccoli, potatoes, carrots, parsnips, onions, beet
Forage crops to include hay, silage, haylage and treated whole crop cereals

Unit content

Storage processes

Chilling, refrigeration, controlled atmosphere, acidification

Control of the deterioration

Timeliness, perishable crops
Storage area preparation: suitable, decontaminated and cleaned, minimise risk of contamination
Crop health: removal of diseased, damaged, oversize and undersize crop, removal of green waste, soil, stones and debris, removal of field heat (crop temperature reduction)
Crop treatment into and in store: chemical, air, temperature and environmental control

Unit 329 Mechanised Agricultural Crop handling and Storage

Outcome 4 Be able to use machinery and equipment used for handling, cleaning, grading and weighing crops

Assessment Criteria

The learner can:

1. **Operate appropriate equipment** for handling, cleaning, grading and weighing **selected crops safely**
2. Describe the **selection and use of equipment** for handling, cleaning, grading and weighing selected crops.

Range

Cover a minimum of one of the following categories:
Soft fruit to include strawberries and raspberries
Vegetables to include lettuce, cabbage, cauliflower and broccoli
Forage crops to include hay, silage, haylage and treated whole crop cereals
Cereals to include wheat, barley, oats, beans, peas, oilseed rape

Unit content

Safely operate

Pre-operation: controls, pre-start checks, health and safety requirements, safe start and stop procedures, power take off (PTO) guards, fitness for purpose
In operation: appropriate attachment for machine, controls, adjustments, safe working with machine and attachments, fitness for working environment, use of codes of practice and manufacturer's instructions

Appropriate equipment

Handling: forklifts, tractor, trailer, boxes, augers, conveyors
Cleaning, grading and weighing: riddles, washers, brushers, sizers, weighing machines

Selection and use of equipment

Cost, crop volume and size, relation to rate of harvesting, final use of crop, length of time in store, system design, equipment compatibility, local climatic conditions, codes of practice and legislation

Unit 329 Mechanised Agricultural Crop handling and Storage

Notes for guidance

This unit is designed to give the learner a broad knowledge of the handling and storage requirements for a range of crops and experience of using related equipment.

It is unlikely that either centres or single enterprises will have the range of facilities covered by this unit. It is essential therefore that delivery of this unit is supported by visits, videos and computer searches to ensure that the range is covered. Some of the learning may best be provided by research assignment based work. It is important that as much of this until as possible is delivered in a real practical environment.

Outcome 1 enables the learner to know and understand the systems available for the drying and storage of combinable crops. Whilst there is a requirement for some formal delivery understanding is best gained in a practical situation. An understanding of the influence of both local climatic conditions and future crop use is important as this will affect crop drying and storage system selection.

Outcome 2 covers the requirements of root crop storage. The biggest crop stored is potatoes and emphasis should be based on this, other crops such as carrots, parsnips, swedes and turnips should be mentioned. Emphasis should be given to requirement for clean healthy crops into store to ensure good store life.

Outcome 3 covers the storage of field scale vegetables, soft fruit or forage crops in store. This is a wide range and either crops for human consumption or forage crops could be selected. The storage of soft fruit particularly, but also of vegetable crops, can be specialist and expensive and not all centres are likely to have a sufficient range of equipment to support the delivery. Visits to suitable farms or pack-houses will greatly enhance the delivery of this outcome.

Outcome 4 enables the learner to gain experience in the use of equipment for handling, cleaning, grading and weighing equipment. This equipment will include both moveable equipment such as forklifts and tractors and fixed equipment such as grading, cleaning and sorting lines. Emphasis here must be on safe operation and selection of suitable clothing and where appropriate Personal Protective Equipment (PPE) and safe working practice.

Centres are encouraged at this level to introduce employers and specific professionals from industry to provide specialist and relevant information to the learner.

It is recommended that formal lectures are linked directly with interactive lessons in a real working environment. Learners must be given the opportunity to see a range of handling and storage systems for a diverse range of crops.

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Farmers Weekly
Landwards- IAgrE

Websites

www.bsonline.co.uk	British Sugar
www.environment-agency.gov.uk	Environment Agency
www.hgca.com	Home Grown Cereals Authority
www.potato.org.uk	British Potato Council

Unit 330 Understand the Principles of Animal Biology

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of animal biology. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

The aim of this unit is to develop the learner's knowledge and understanding of the structure and function of cells and tissues and their relationship with body systems. This will be developed through an understanding of the structure and function of skeletal systems and sensory organs and how these have been adapted to meet the needs of animals living in different environments.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know the functions of the main animal cell organelles
2. Understand the structure and function of the main animal tissue types
3. Know the structure and function of animal skeletal systems
4. Know the structure and function of sensory organs in animals

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

N/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge.

Unit 330 Understand the Principles of Animal Biology

Outcome 1 Know the functions of the main animal cell organelles

Assessment Criteria

The learner can:

1. Identify **cell components**
2. Describe the **functions** of cell **organelles**
3. Identify the stages of **mitosis and meiosis**

Range

Species should be broadly mammalian but reference to other living organisms to be made where appropriate

Unit Content

Cell components and organelle function

Identification of the following cell components by appearance: nucleus (nucleolus, nuclear envelope, chromatin), mitochondria, microfilaments, Golgi apparatus, rough endoplasmic reticulum, smooth endoplasmic reticulum, ribosomes, centrioles, plasma/cell membrane, cilia, lysosomes, vacuoles

The main contribution each organelle makes to cellular function

Mitosis and meiosis

Role of chromosomes in passing on genetic information, purpose of cell division via mitosis and meiosis, description of each of the following stages:

Mitosis: interphase, prophase, prometaphase, metaphase, anaphase, telophase, cytokinesis

Meiosis: prophase I, prometaphase I, metaphase I, anaphase I, telophase I, (cytokinesis may or may not occur), interphase II, prophase II, metaphase II, anaphase II, telophase II, cytokinesis

Unit 330 Understand the Principles of Animal Biology

Outcome 2 Understand the structure and function of the main animal tissue types

Assessment Criteria

The learner can:

1. Categorise different tissue types
2. Explain the structure of **the main tissue types**
3. Explain the function of **the main tissue types**

Range

Species should be broadly mammalian but reference to other living organisms to be made where appropriate.

Unit content

The main tissue types

Epithelial tissue

Structure and functions of simple epithelial tissue (squamous, columnar, ciliated columnar, cuboidal, glandular, transitional) and stratified epithelial tissue (e.g. skin)

Connective tissue

Basic structure of connective tissue (cells secrete extracellular protein fibres to form a matrix) Structure and functions of the following: dense (binding), regular and irregular, loose (fibrous), supporting, fluid

Nervous tissue

Basic neurone structure: cell body, axon, dendrites, dendron, terminal knobs; myelin sheath, Schwann cells and nodes of Ranvier, saltatory conduction of the action potential, structure of the synapse, difference in structure between sensory and motor neurones, monosynaptic and polysynaptic reflex arcs

Muscle tissue

Location, structure and function of the following muscle tissues: skeletal, cardiac, smooth Sliding filament theory of muscle contraction, fast and slow muscle

Unit 330 Understand the Principles of Animal Biology

Outcome 3 Know the structure and function of animal skeletal systems

Assessment Criteria

The learner can:

1. Identify the **component parts of the animal skeletal system**
2. Describe the **functions of the animal skeletal system**
3. Describe **adaptations** of selected **skeletal** systems of animals living in different environments

Range

Species should be broadly mammalian but reference to other living organisms to be made where appropriate

Unit content

Component parts of the animal skeletal system

Axial and appendicular skeleton, divisions of the vertebral column, the limb bones, carpals and tarsals, metacarpals and metatarsals; phalanges
Jaws and dentition in carnivores, omnivores and herbivores
Joint types: fibrous (fixed), cartilaginous (e.g. between vertebrae), synovial (ball and socket, pivot, hinge, gliding)
Function of synovial fluid and capsule
Tendons (bone to muscle) and ligaments (bone to bone), limited to allowing locomotion of the skeleton and stabilising joints

Functions of the animal skeletal system

Locomotion, protection of internal organs, support, storage of calcium and phosphorous, blood cell formation

Skeletal adaptations

Evolution of skeletal adaptations in vertebrates: aquatic mammals (cetaceans), flying mammals (bats), hopping mammals (rabbits), running (horses)

Unit 330 Understand the Principles of Animal Biology

Outcome 4 Know the structure and function of sensory organs in animals

Assessment Criteria

The learner can:

1. Identify the **sense organs** in animals
2. Describe the **structure of sense organs** in selected animals
3. Describe the **function of sense organs** in selected animals

Range

Species should be broadly mammalian but reference to other living organisms to be made where appropriate.

Unit content

Sense organs

Eyes, ears, nose, mouth, special sensory organs (e.g. electroreceptors in fish, lateral line system), tactile organs (e.g. platypus beak, vibrissae)

Structure and function of sense organs

Link between stimuli and sense organs (e.g. light and sight). Importance of sensory perception for predators and prey, including echolocation

Structure of the eye and ear as follows:

Eye: Cornea, pupil, iris, ciliary body, lens, sclera, retina (rod and cone cells), choroid, fovea, optic disc, optic nerve, medial and lateral rectus muscles

Ear: External: auricle (pinna), tympanic membrane. Middle: malleus, incus, stapes, auditory ossicles. Inner: oval window, round window, cochlea, organ of Corti, cochlear nerve

Comparison of sensory organs, including typical eye position and structure of external ears, between predator and prey species (e.g. rabbit and dog)

Unit 330 Understand the Principles of Animal Biology

Notes for guidance

This unit is designed to equip the learner with sound knowledge of the basis of how the animal body functions under normal conditions. Depending on what qualification the unit is delivered through, the context of teaching will differ. The unit should cover a range of species as appropriate to the area of study, with reference to other species where indicated in the specification for comparison purposes. Species should be broadly mammalian but reference to other living organisms to be made where appropriate.

Tutors have many opportunities to deliver the unit using a wide range of learning approaches: lectures, discussions, seminar presentations, supervised dissections and live animal handling. Tutors should consider integrating the delivery and private study of this unit with other relevant units.

It is expected that learners will be familiar with safe working practice around potentially hazardous equipment, materials and animals. The learner should be taught how to recognise hazards and risks and should also be able to use information to manage potential risks to themselves and others as appropriate.

Outcome 1 is the basis of cell biology. Electron micrographs of cells should be used to illustrate cell organelle structure, while learners can appreciate the 3-D nature of a cell by constructing models from modelling clay. There are many animations and other useful resources available on the internet that may be used either for independent study or whole-group teaching (see reference materials). Relationships between cell types and the functions of the associated tissue should be emphasised e.g. ciliated cells lining the respiratory tract are able to work together in order to waft mucus containing foreign particles away from the respiratory surface.

Outcome 2 involves categorising and investigating the properties of different tissue types Light microscopy to look at prepared histological samples is recommended, as is practical dissection if possible. Scientific drawing of samples is useful practice and the results could form part of a poster constructed by the learner during independent study of the outcome.

Outcome 3 requires access to real or model skeletons for a full appreciation of how the skeleton works and learners will be able to comment on the advantages and disadvantages of the skeletal adaptations (including dentition) within the range of species, as well as applying the basic theory to other animals, including fossils of extinct animals. The use of timelines is recommended to illustrate the great lengths of time involved in the process of evolution. Case studies comparing normal function of skeletal components against those that are diseased or injured can be useful to highlight the importance of the skeletal system.

Outcome 4 examines the interaction of the animal with its environment and high quality audio-visual resources (such as Attenborough's 'Life of Mammals) allow the learner access to the diversity of sensory development in animals across the world. Assigning groups or individuals with projects, presentations and independent research are potential methods of gaining a large amount of information on interesting species, hence motivating and enthusing the learner. Species analysed should include some with unusual sensory receptors, such as fish and their lateral line systems, the bill of the duck-billed platypus and the vibrissae of the star-nosed mole. A comparison between predator and prey species should be emphasised at each stage. Theory sessions on the structure and function of the mammalian eye and ear would be enhanced by dissections of eyes if facilities allow and simple experiments (e.g. the blind spot, pupil shape in different animal species, hearing sensitivity experiments).

References

Books

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Websites

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www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.wales.gov.uk	Welsh Assembly Government
www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)

http://www.cellsalive.com

http://sixthsense.osfc.ac.uk/biology/study_guide.asp

http://www.zoology.ubc.ca/~bio310/121T_files/06S_celldivision.htm

http://www.purchon.com/biology/animal.htm

Unit 331 Participate in Business Planning and Improvement in the Land-based Sector

Level: 3

Credit value: 10

Unit aim:

This unit aims to provide learners with an understanding of the principles of business planning and improvement in the land-based industries and how these can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

The learner will explore business improvement, including opportunities for diversification, how it can give a competitive advantage and reduce environmental impact. They will learn the skills necessary for developing a business idea, and preparing a business plan.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand business improvement in land-based industries
2. Be able to identify and plan opportunities for practical business improvement
3. Be able to develop a land-based business idea
4. Be able to prepare a business plan

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

n/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 331 Participate in Business Planning and Improvement in the Land-based Sector

Outcome 1 Understand business improvement in land-based industries

Assessment Criteria

The learner can:

1. Describe **strategies** that a land-based business can adopt to **improve performance**
2. Describe ways that a land-based business can achieve **competitive advantage**
3. Describe how a land-based business can improve its **environmental impact**

Unit content

Strategies

Consolidation, expand market share, product development, market development, diversification, (opportunities and risks) and Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis

Improve performance

Improved effectiveness and efficiency in key business functional areas, e.g. products, services, marketing, customer relations, staffing, staff management, working practices, production efficiency, financing, financial control, internal factors impacting on business performance (e.g. resources and management), external factors impacting on performance (e.g. political, economic, socio-cultural and technological)

Competitive advantage

Price, differentiation (e.g. quality, location, customer service and perceived added value), use of marketing mix (product, price, place and promotion)

Environmental impact

Resource use, waste, recycling, pollution (chemical, biological, visual, audible, light), road traffic, carbon footprint, enhancement of the environment (e.g. preservation or creation of habitats, conservation of structures), principles of sustainability, relevant environmental legislation (e.g. Wildlife and Countryside Act 1981 (as amended 1991), Environmental Protection Act 1990 (as amended 1995), Control of Substances Hazardous to Health (COSHH) 2002, The Control of Pollution Regulations (Oil Storage) (England) Regulations 2001, Water Framework Directive (WFD), Cross Compliance, Nitrates Directive, Waste Management (England and Wales) Regulations 2006

Unit 331 Participate in Business Planning and Improvement in the Land-based Sector

Outcome 2 Be able to identify and plan opportunities for practical business improvement

Assessment Criteria

The learner can:

1. Identify **potential improvements** in a business within a land-based context
2. Prepare a **plan for achieving business improvements** or **diversification** within a land-based context

Unit content

Potential improvements

Improvements in key business functional areas, e.g. products, services, marketing, customer relations, staffing, staff management, working practices, production efficiency, financing, financial control, importance of continuous improvement

Plan for achieving business improvements

Specific actions, rationale, timescale, resource implications, financial implications (costs, likely returns), key factors for success and risks

Diversification

Opportunities for diversification (e.g. forward, backward, horizontal), related, unrelated, evaluation of opportunities in relation to resources, skills and finance needed

Unit 331 Participate in Business Planning and Improvement in the Land-based Sector

Outcome 3 Be able to develop a land-based business idea

Assessment Criteria

The learner can:

1. Develop a land-based **business idea**
2. **Research the market** for a land-based business idea

Unit content

Business idea

Establishment of a new business, diversification or development of new enterprise and implement improvements to an existing business

Research the market

Market analysis (size, trends, competition, segmentation, target market), primary and secondary research

Unit 331 Participate in Business Planning and Improvement in the Land-based Sector

Outcome 4 Be able to prepare a business plan

Assessment Criteria

The learner can:

1. Produce a **business plan** to meet given specifications
2. **Present** a land-based business plan

Unit content

Business plan

Purposes of the business plan, business products or services, aims and objectives, market analysis (size, trends, competition, segmentation, target market), physical resources (e.g. property, machinery, vehicles, equipment and stock), human resources (staffing structure, management and key personnel, job descriptions and person specifications), promotion (media and cost), financial forecasts (setting up costs, pricing, income, costs, profit and monthly cash flow forecast), finance needs, sources of finance (equity, borrowing and grants), legal issues e.g. legal status (sole trader, partnership, company, franchise and co-operative), trading terms and conditions, trading standards, licences, relevant current legislation, planning permission, health and safety, fire regulations, regulatory bodies, sources of advice (solicitor, accountant)

Present

Different audiences (e.g. bank, investors and business management), written report format, oral presentation

Unit 331 Participate in Business Planning and Improvement in the Land-based Sector

Notes for guidance

This unit allows learns to explore the importance of improvement and planning for future business development. It should be related to the types of business relevant to the learners' vocational area and can include all forms of business, including not-for-profit organisations, not just commercial private sector businesses.

In Outcome 1, learners will investigate how business improvement should be sought in all of the key functional areas. They will discover that a sound business strategy derives from an understanding of current strengths, weaknesses, opportunities and threats and provides a focus for future improvements and development. They will also learn about the importance of sustainability and the need for businesses to reduce their environmental impact. The use of case studies and business visits would enhance the learning about these issues.

Outcome 2 progresses from the learning about business improvement in outcome 1. Learners will identify specific improvements that could be made in a selected business from some of the key functional areas listed. These improvements could involve opportunities for business diversification, but learners should be cautioned that diversification is often a high risk strategy and opportunities need to be carefully evaluated. They will need to prepare a detailed plan for implementation of proposed improvements.

Outcomes 3 and 4 include a broad range of content and delivery of the module should allow for this. In outcome 3 learners need to propose a land-based business development. This could be based on business improvements or developments identified in outcome 2, a diversification proposal or for a new business start-up.

In Outcome 4, learners need to prepare a business plan for the business idea developed in Outcome 3. The completed business plan should be addressed to a specific audience and include business products or services, aims and objectives, market analysis, physical resources, human resources, promotion, financial forecasts, finance needs, sources of finance, legal issues. It would help learners if they can be provided with a suitable template for construction of the business plan.

Centres are encouraged to introduce employers and specific professionals from industry to provide interesting and relevant information to the learner. Teaching would also benefit from visits to a variety of establishments to add depth to the learner experience.

References

Books

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Jones, R. Raffo, C. and Hall, D. 2004. *Business Studies*, 3rd Edition Causeway Press

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Warren, M. 1997. *Financial Management for Farmers and Rural Managers* Blackwell

Lewis, R. & Trevitt, R. 1997. *BTEC National Business* Nelson Thornes

Dooley, D. Dransfield, R. 2007 Goymer, J. & Guy, P. *BTEC National Business* Heinemann

Barrow, C. Tiffany P & Peterson S 2004*Business Plans for Dummies* (John Wiley & Sons)

Finch, B. 2006. *How to Write a Business Plan* Kogan Page

Unit 332 Understand and Use Agricultural Spreaders and Sprayers

Level: 3

Credit value: 10

Unit aim

This unit aims to introduce learners to the skills and knowledge needed for agricultural spreaders and sprayers, and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

The learner will develop an awareness of the equipment and techniques used to apply agri-chemicals and fertilisers, the routine maintenance and use of sprayers and spreaders, and the legislation that applies to their operation. They will develop practical skills needed to safely operate and maintain sprayers and spreaders and investigate the impact of developments in agricultural application machinery on operator safety, the wider environment and the effects on the perception of modern agricultural practices.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand how machinery is used for the application of pesticides and fertilisers to agricultural crops
2. Be able to prepare, operate and maintain application and spreading machinery
3. Know the factors affecting efficiency and accuracy of pesticide and fertiliser placement
4. Know the impact of developments in application technology on operator safety and environmental protection standards

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

N/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- A range of assignments covering practical skills and underpinning knowledge

Unit 332 Understand and Use Agricultural Spreaders and Sprayers

Outcome 1 Understand how machinery is used for the application of pesticides and fertilisers to agricultural crops

Assessment Criteria

The learner can:

1. Explain the **operation** of selected **machinery** used to apply agri-chemicals and fertilisers to **agricultural crops**
2. Evaluate the use of different **machinery** in the application of pesticides and fertilisers to agricultural crops

Range

Machinery

Pesticides application machine: trailed or mounted or self propelled hydraulic sprayer, weed wiper, knapsack sprayer, controlled droplet application, boom sleeved sprayers, variable geometry booms
Fertiliser application: trailed and mounted machines, single/twin spinning disc, oscillating spout, pneumatic discharge
Materials: liquids, granules, compounds, powders

Unit content

Operation

Power source, mechanical drive, lines, hydraulic circuits, pneumatic systems, electronic control, filtration, application rates

Agricultural crops

Combinable crops: wheat, barley, oats, rye seed, oil seed rape
Grass and forage crops: clover, perennial ryegrass, lucerne, forage maize
Root crops: potatoes, roots, legumes, stubble turnips, sugar/fodder beet, potatoes
Alternative crops: e.g. lupins, linseed

Unit 332 Understand and Use Agricultural Spreaders and Sprayers

Outcome 2 Be able to prepare, operate and maintain application and spreading machinery

Assessment Criteria

The learner can:

1. Ensure **equipment** is **prepared** in a **safe and effective condition**
2. Safely **operate** application machinery to meet given objectives
3. Safely **maintain** application equipment to meet given objectives

Range

Equipment

Pesticides application machine: trailed or mounted or self propelled hydraulic sprayer, weed wiper, knapsack sprayer, controlled droplet application, boom sleeved sprayers, variable geometry booms
Fertiliser application: trailed and mounted machines, single/twin spinning disc, oscillating spout, pneumatic discharge
Materials: liquids, granules, compounds, powders

Unit content

Preparation

Linked to power sources, correct linkage/drawbar adjustment, decontamination of previous materials/residue, lubrication, clear filtration, initial calibrations/output settings, safe operation of controls, wheel and tyre adjustment, Personal Protective Equipment (PPE), traction/stability aids, ground compaction

Safe and effective condition

Decontamination, leakage/spillage, component security, replacement of worn/damaged components, pre-operation tests

Operation

Transport to site, site assessment, method of work, headland margins, working in lands, tramlining, use of marker systems, watercourses, ground conditions, wind/weather conditions, obstacles, public/animal access, load shifting on slopes, safe transport of fertiliser and pesticides, field/site loading of materials, headland work, assessment on machine performance, PPE, operator legislation and certification, warnings to public, animal exclusion periods, harvest intervals

Maintenance

Lubrication, pre-season maintenance, pre-storage maintenance, manufacturers recommendations, in season maintenance, scheduling maintenance within work requirements, cleaning, decontamination, cleanings/washings pollution control, recognition of worn parts, replacement parts, PPE, safe waste disposal, containers/bags/boxes/ contaminated PPE/replaced components

Unit 332 Understand and Use Agricultural Spreaders and Sprayers

Outcome 3 Know the factors affecting efficiency and accuracy of pesticide and fertiliser placement

Assessment Criteria

The learner can:

1. Describe **variables** affecting the **efficiency and accuracy** of pesticide and fertiliser placement
2. Identify **impacts on changing variables** on efficiency and accuracy of pesticide and fertiliser placement

Range

Pesticides application machine: trailed or mounted or self propelled hydraulic sprayer, weed wiper, knapsack sprayer, controlled droplet application, boom sleeved sprayers, variable geometry booms
Fertiliser application: trailed and mounted machines, single/twin spinning disc, oscillating spout, pneumatic discharge
Materials: liquids, granules, compounds, powders

Unit content

Variables on output

Fertiliser application: accurate calibrations, material types/quality, materials flow characteristics, moisture, disc/spout, boom and deflector condition, balance of spread, wind conditions, ground conditions, forward speed, power input speed, materials flow rate, power unit wheel slip, spreading height
Pesticide application: accurate calibrations, oil/water based pesticides, granules, emulsions, pellets, nozzle types, pressures, pump performance, boom alignment, wind speed, ground conditions, forward speed, power unit wheel slip, boom height, spray quality

Efficiency and accuracy

Suitable product, correct output, over/under lapping, double dosing headlands, loss due to wind drift, evaporation, use of wetters/spreaders/adhesion agents, load cells/re-calibration devices, Global Positioning Satellite (GPS), computerised output monitoring/automatic rate control

Impact on changing variables

Increase/reduce costs, increase/decrease work rates, over/under lapping, decrease in output may lower effectiveness or/and decrease yield, increase in output may burn/damage crop and/or decrease yield, residual build up in soil, high pesticide/nitrate count in crop product

Unit 332 Understand and Use Agricultural Spreaders and Sprayers

Outcome 4 Know the impact of developments in application technology on operator safety and environmental protection standards

Assessment Criteria

The learner can:

1. Describe impacts of **developments in application technology** on **operator safety**
2. Describe impacts of developments in application technology on **environmental protection standards**
3. Identify **legislation** relevant to the application of pesticides and fertilisers

Range

Pesticides application machine: trailed or mounted or self propelled hydraulic sprayer, weed wiper, knapsack sprayer, controlled droplet application, boom sleeved sprayers, variable geometry booms
Fertiliser application: trailed and mounted machines, single/twin spinning disc, oscillating spout, pneumatic discharge
Materials: liquids, granules, compounds, powders

Unit content

Developments in application technology

Spreaders: PPE recommendations, materials packaging, product labelling/data sheets, machine hitching systems, centre of gravity, calibration systems
Sprayers/ pesticides application: PPE recommendations, materials packaging, product labels, data sheets, waste disposal methods, engineering controls, nozzle designs, self cleaning filters, tank rinse systems, pesticides measuring and induction systems, auto fold booms, decontamination systems, rate controllers

Operator safety

Safe hitching procedures, contamination through ingestion, inhalation, absorption, materials storage systems, safe lifting and operator fatigue

Environmental protection standards/legislation

Local Environment Risk Assessment for Pesticides (LERAP), Nitrate Vulnerable Zones (NVZ), headland margins/buffer zones, Sites of Special Scientific Interest (SSSI), chemical storage, transport of chemicals, waste management regulations, Food and Environmental Protection Act 1985, (FEPA), Control of Pesticides Regulations,1986 (COPR), Health and Safety at Work etc Act1974, Control of Substances Hazardous to Health,2002(COSHH), Groundwater Regulations,1998, Provision and Use of Work Equipment Regulations 1998 (PUWER), Plant Protection Product Regulations (2005), relevant Codes of Practice

Unit 332 Understand and Use Agricultural Spreaders and Sprayers

Notes for guidance

This unit is designed for the learner who will be applying fertilisers and pesticides to grassland and/crops. It will give the learner an insight into machine availability and capability, safe working practices and procedures, accuracy of application and legislations affecting operators, the general public and environment.

Technological advances have been made to chemical application machines which allows for operator ease of use, operator safety and environmental safety. The learning areas in this unit, when consolidated, should allow for safe, efficient use of equipment and application of fertiliser and pesticides.

Throughout the unit the emphasis will be on safe practices and it is envisaged that all learners assessed to be competent in the operation of power units prior to carrying out any field, work practice. Equipment used must be in safe, useable condition and decontaminated to minimise the risk of operator contamination, substitutes for pesticides are to be used when operating sprayers.

During delivery of this unit it should be emphasised that success in this unit will not entitle operators to apply pesticides unless the relevant certification is held.

To meet the requirements of legislation and Chemical Regulatory Directorate (CRD), learners are required to achieve PA1 and the appropriate application unit(s) (PA2 – PA13) from the Level 2 Award in the Safe Use of Pesticides (QCF) or Level 2 Certificate of Competence in the Safe Use of Pesticides to apply pesticides for commercial use. Achievement of this unit (352 Understand and Use Agricultural spreaders and Sprayers) does not cover the legislative requirements for applying pesticides.

Outcome 1 focuses on the principles of how machinery is used to apply fertilisers and pesticides to agricultural crops. Learners would benefit from practical demonstrations on the use of the machinery to assist with the delivery of this outcome. This outcome could be delivered along with Outcome 2 for the practical demonstrations.

Outcome 2 covers the practical operation of applying pesticides and fertilisers. Learners will also cover the practical skills required to prepare and maintain the application equipment. The delivery of this outcome could benefit from visits to agricultural sites where spreaders and sprayers are being used. This outcome could be delivered in conjunction with Outcome 1.

Outcome 3 covers the principles of the efficiency and accuracy of pesticide and fertiliser placement and the impacts of the variables changing. The classroom delivery of this outcome could be assisted by discussions, presentations and visits to agricultural sites.

Learning Outcome 4 focuses on the impacts of the technology used for spreading and spraying fertilisers and pesticides. The relevant legislation is also covered in this outcome. This outcome could be delivered in the classroom along with practical demonstrations.

Centres are encouraged to introduce employers and specific professionals from the industry to provide interesting and relevant information to the learner.

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www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.environment-agency.gov.uk	Environment Agency
www.cityandguilds.com	City & Guilds
www.profi.com	Profi International

Unit 333 Fundamentals of Science

Level: 3

Credit value: 10

Unit aim:

The aim of this unit is to enable learners to develop the practical techniques necessary to pursue a potential career in science. Learners will investigate the quantities necessary in chemical reactions, structure and functions of cells, calorific value of different fuels and develop skills in communicating scientific information.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Be able to use the necessary skills to measure quantities for chemical reactions
2. Be able to use the correct equipment to identify structures and functions in different cell types
3. Be able to investigate different types of energy and their transfers
4. Be able to communicate scientific information

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

N/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 333 Fundamentals of Science

Outcome 1 Be able to use the necessary skills to measure quantities for chemical reactions

Assessment Criteria

The learner can:

1. Outline the key **features** of the periodic table, **atomic structure** and chemical **bonding**
2. Demonstrate practically the ability to **prepare chemical solutions** and **test their accuracy**

Unit content

Features

Metals and non-metals including transition metals, halides, noble gasses, significance of atomic mass, atomic number and changes in group and period

Atomic structure

Elements, mixtures and compounds. Mass and charge of protons, neutrons and electrons and how that structure can derive from the periodic table. Principle of electron shells and how these are filled. Structure and uses of isotopes

Bonding

The formation of ionic, covalent and hydrogen bonds and the relevance of Van de Waals forces. Use of the periodic table to determine the structure of simple ionic and covalent compounds. Balancing chemical equation

Prepare chemical solutions

Difference between precision and accuracy. Handling and measurement of solids and liquids including both weight and volume measurements with an emphasis on safe working practice. Preparation of solutions based upon w/w, w/v and v/v measurements. Serial dilution of solutions and mixing of solutions of different molarities to obtain the required concentrations. Preparation, dilution and mixing of molar solutions. Preparation of acid and alkali solutions, calculation and measurement of pH

Test their accuracy

Measurement of the concentration of solutions by a common industrial assay such as by a titration, colourimetric or spectrophotometic technique

Unit 333 Fundamentals of Science

Outcome 2 Be able to use the correct equipment to identify structures and functions in different cell types

Assessment Criteria

The learner can:

1. Accurately record observations of different **types of tissues** from a light microscope
2. Interpret electron micrographs of different **types of tissues**
3. Describe the key **structures and functions** of a eukaryotic and prokaryotic cell

Range

Cell types: eukaryotic, prokaryotic
Tissue types: epithelial, connective, nervous, muscle

Unit content

Tissue types

Dense, loose, regular, irregular and fluid connective tissues. Simple and stratified epithelial tissues. Skeletal, cardiac and smooth muscle types. Nervous tissue

Structures and functions

Structure and function of cell walls (prokaryotic and eukaryotic), nucleoid, cytosol, flagella, pili, plasmids, cytoskeleton, cell membrane, chloroplasts, centrioles nucleus, rough and smooth endoplasmic reticulum, ribosomes, Golgi apparatus, mitochondria, endosymbiosis theory, peroxisomes and lysosomes

Unit 333 Fundamentals of Science

Outcome 3 Be able to investigate different types of energy and their transfers

Assessment Criteria

The learner can:

1. Describe different types of **energy transfer**
2. Carry out a practical investigation into the calorific value of **different fuels**

Range

Thermodynamics, photosynthesis and cellular respiration in eukaryotes, calorimetric determination

Unit content

Energy transfer

First, second and third laws of thermodynamics. Enthalpy calculation and measurement. Photosynthesis in plant cells and the production of ATP in both animal and plant cells including an outline of glycolysis, citric acid cycle and oxidative phosphorylation. Formation of electrochemical gradients and potential difference across membranes

Different fuels

Calorimetric determination of carbohydrate, lipid based food products and a hydrocarbon fuel fraction and an organic solvent

Unit 333 Fundamentals of Science

Outcome 4 Be able to communicate scientific information

Assessment Criteria

The learner can:

1. Outline the **methods** by which scientific information is communicated
2. Report on a **scientific investigation** that has been carried out

Range

Peer reviewed and non-peer reviewed methods in a range of media

Unit content

Methods

Peer reviewed and non-peer reviewed sources. Journals, books (academic texts, fiction and non-fiction), newspaper and magazine articles, television and radio documentaries and advertising, academic and industry conferences, poster presentation, electronic distribution, websites and educational resources

Scientific investigation

Sourced from published primary sources or from learners own investigation which may be from this unit or another suitable investigation

Unit 333 Fundamentals of Science

Notes for guidance

This unit aims to provide learners with a grounding in a range of both theoretical and practical scientific skills that underpin the life sciences. It is envisaged that although the content of this unit is necessarily general it should, wherever possible, be contextualised to the final qualification being undertaken.

Practical laboratory investigations are an important feature of this unit and as such learners will be aware and familiar with relevant safe working practices before any investigation is undertaken.

Outcome 1 introduces learners to the periodic table and although formal lectures will form an element of delivery this outcome provides an opportunity for learners to practice the skills required in chemical calculations. The practical element enables learners to produce a range of solutions and test their accuracy using methods should be derived from those used in industry or research laboratories. This practical activity also allows learners to gain knowledge about potential chemical hazards such as the preparation and mixing of alkali and acidic solutions. CLEAPSS produce a range of resources that may help in preparing for this element of outcome 1.

Outcome 2 introduces learners to eukaryotic and prokaryotic life including the structure and function of cellular organelles. Electron micrographs provide sufficient magnification for learners to practice the identification of cell organelles. This outcome also allows learners to study the organisation of cells into tissue types and the role of these tissue types in a variety of organs and organ systems. Example slide sets are available from a range of educational suppliers. Although standard light microscopy is sufficient some tissue types may benefit from examination under oil immersion microscopy. If possible learners should be given the opportunity to measure cells using an eye piece graticule.

In Outcome 3, learners will gain a working knowledge of energy transfer and the laws of thermodynamics which should be contextualised to animal examples. However physical examples may help learner grasp concepts before being applied to biological systems. Calorimetric determination forms the investigative element of this outcome and may be carried out inexpensively with standard laboratory glassware, a more accurate and inexpensive alternative is copper calorimetric apparatus and if funds allow bomb calorimeters may now be purchased from educational suppliers. Learners should be encouraged to not only compare the fuels but to relate these to contextualise their finding to industrial examples and to evaluate the methods used.

In Outcome 4, learners will review a variety of methods used to communicate scientific finding to academia, industry and the general public. Learners have the opportunity to evaluate each of these methods in terms of their reliability, impact, accuracy and bias. Learners should explore examples of good and poor practice in the reporting of scientific results especially where scientific results have been misinterpreted. Learners should explore how poor study design and interpretation can have serious implications, such as the debate over the MMR vaccine. Learners should also explore the impact of popular science television and radio documentaries which reach large numbers of the public and be able critically evaluate these sources. This outcome also allows learners to report on a scientific finding and should take the form of one of the form studied. Learners may use one of their own investigations for this unit or another suitable unit. Alternatively learners may take an existing publication, such as a journal paper, and produce a report in an alternative media such as a webpage, popular press article, podcast or broadcast.

Centres are encouraged to engage employers and other institutions where possible and this unit would benefit from such engagements. Possible activities may involve visits to analytical laboratories, food processing facilities, local and national media organisations.

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Biochemistry and Molecular Biology Education – John Wiley and Sons

Biochemical Education – Elsevier Science

Journal of Biological Education – Institute of Biology

Journal of Microbiology and Biology Education – American Society for Microbiology

New Scientist, Reed Business Information

Websites

www.cleapss.org.uk	Consortium of Local Education Authorities for the Provision of Science Services
www.ase.org.uk	The Association for Science Education
www.ncbe.reading.ac.uk	National Centre for Biotechnology Education
www.royalsociety.org	The Royal Society

Unit 334 Understand the Principles of Inheritance and Genetic Manipulation

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of inheritance and genetic manipulation. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

The aim of this unit is to develop knowledge and understanding of the principles of inheritance and the applications of genetic manipulation in animals.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will be able to:

1. Understand the molecular basis of inheritance
2. Understand the principles of Mendelian genetics
3. Understand the principles of population genetics
4. Know the principles of genetic manipulation

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

n/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 334 Understand the Principles of Inheritance and Genetic Manipulation

Outcome 1 Understand the molecular basis of inheritance

Assessment Criteria

The learner can:

1. Describe the **structure of DNA**
2. Describe **DNA replication**
3. Describe **chromosomal structure**

Range

Eukaryotic cells

Unit content

Structure of DNA

DNA, RNA (including tRNA, mRNA and rRNA)

DNA replication

Semi-conservative replication (Meselson-Stahl experiment), enzymatic involvement, importance and mechanisms of proof-reading and repair, replication forks, Okazaki fragments

Chromosomal structure

Euchromatin, heterochromatin, nucleosomes, genes, alleles, telomeres, chromatids, karyotypes

Unit 334 Understand the Principles of Inheritance and Genetic Manipulation

Outcome 2 Understand the principles of Mendelian genetics

Assessment Criteria

The learner can:

1. Explain how the **behaviour of chromosomes during meiosis** leads to variation
2. Explain **monohybrid and dihybrid inheritance ratios**

Range

Diploid species of animal

Unit content

Behaviour of chromosomes during meiosis

Homologous pairs, crossing over (effect of distance on linked genes), independent assortment

Monohybrid and dihybrid inheritance ratios

Continuous and discontinuous variation, dominance (complete and incomplete), heterozygous and homozygous genotypes, genetic diagrams for both monohybrid and dihybrid crosses to F2 generation, including phenotypic ratios and probability calculations

Unit 334 Understand the Principles of Inheritance and Genetic Manipulation

Outcome 3 Understand the principles of population genetics

Assessment Criteria

The learner can:

1. Describe the process of **evolution through natural selection**
2. Describe the **effect of mutations on variation**
3. Explain evolution in terms of the **Hardy-Weinberg Principle**

Unit content

Evolution through natural selection

Adaptations, stabilising, directional and disruptive selection

Mutations

Harmful, beneficial and neutral mutations

Spontaneous and induced mutations and their effects: point, insertion, deletion, translocation, duplication, frameshift, nonsense, missense, neutral and silent

Hardy-Weinberg Principle

Gene pools, genetic drift, gene flow, conditions for Hardy-Weinberg equilibrium, use of $p^2+2pq+q^2 = 1$ to illustrate evolution of populations

Unit 334 Understand the Principles of Inheritance and Genetic Manipulation

Outcome 4 Know the principles of genetic manipulation

Assessment Criteria

The learner can:

1. Describe **techniques used in genetic manipulation**
2. Identify **applications of genetic manipulation**
3. Evaluate the **advantages and disadvantages of genetic manipulation techniques**

Range

Genetic manipulation in animals, reference to prokaryotic genetic manipulation as necessary to cover the specification

Unit content

Genetic manipulation techniques

Extraction of DNA, gel electrophoresis, use of restriction enzymes, polymerase chain reaction, recombinant DNA technology, use of marker genes, knockout mice (gene targeting), use of vectors in transfection and transduction

Applications of genetic manipulation

Genetic testing, DNA fingerprinting, gene targeting, analysis of gene function and regulation, animal cloning, production of pharmaceuticals from animals (e.g. insulin, alpha-1 antitrypsin)

Advantages and disadvantages of genetic manipulation techniques

Practical limitations of techniques, how limitations might be overcome, commercial, social and ethical considerations of genetic manipulation in animals

Unit 334 Understand the Principles of Inheritance and Genetic Manipulation

Notes for guidance

The context of this unit should be animal-based, though clearly some elements (such as DNA structure) are common to many animals and as such do not require species-specific illustration. The tutor must cover as broad a range as possible in order to for the learner to find the unit relevant and engaging.

The world of genetics is moving at an ever-increasing rate and learners need to be aware of both the basis of inheritance and the applications of genetic manipulation in order to keep pace for further study. It is recommended that up to date journals are used in order to enhance the delivery of this unit for that reason. Wherever possible, the theory should be delivered with practical illustration. First-hand experience of genetic techniques such as DNA extraction can be rewarding and motivating for students without an excessive equipment burden on the tutor. Protocols for this can be found within the reading list. Access to an industrial laboratory would be invaluable experience where possible. It is expected that learners will be familiar with safe working practice, be aware of risk assessments and be equipped with personal protective equipment as necessary throughout all practical work.

Genetics is an area in which great controversy is often provoked. Exploration of the techniques used in genetic manipulation and the potential applications in both domestic and wild animals allows learners to formulate their own, informed views on contemporary issues and may open up avenues of further study for many.

Many links to other scientific units (such as Animal Biology) can be made throughout this unit. Where possible and practical it is recommended that delivery is integrated and these links are emphasised to the learner.

Outcome 1 explores the molecular basis of inheritance. Learners must be aware of the link between structure and function of nucleic acids. Making jigsaw models or using modelling clay can help to make learners aware of the 3D nature of the structures. The sequence of events during DNA replication, including proof-reading and repair, must be covered with the names and roles of enzymes at each stage. Knowledge of chromosomal structure must not be 'stand-alone' but linked to how the structure enables characteristics to be inherited and expressed.

Outcome 2 follows on from outcome 1 and explores the contribution of chromosomal behaviour during meiotic divisions to variation of potential offspring. Knowledge of the stages of meiosis is assumed and hence the requirement here is for a detailed examination of the chromosome behaviour during prophase I and metaphase I, linked to the resultant formation of gametes. Diploid species must be used though learners should be aware of the existence of polyploidy in other species. Learners must be able to construct diagrams of both monohybrid and dihybrid inheritance through to the F2 generation, as well as being able to explain differences between expected and observed phenotypic ratios.

Outcome 3 requires learners to study the principles of population genetics and evolution through natural selection. They must be able to describe and identify the specified mutations, linking them to their relative effects on variation between individuals. They must show an understanding of variation within populations and how species may evolve as a result of alterations to the gene pool. The Hardy –Weinberg principle must be explored in full, with its relevance to evolution. The ability to use the Hardy-Weinberg equation is required.

Outcome 4 requires the learner to be able to describe genetic manipulation techniques. Where possible they should be given the opportunity to carry out techniques or at least observe them being carried out, directly or via video. Learners must be able to describe the equipment, materials and stages in the technique (including timescales). This should lead logically onto examination of practical limitations and how they may be overcome. Applications of genetic manipulation techniques must be individually considered in terms of commercial, social and ethical considerations rather than simply 'genetic manipulation', though this may be a useful starting point from which discussions may begin. Prokaryotes and viruses often play a part in genetic manipulation techniques and as such learners are required to understand how their replication methods allow this to occur.

There are many high quality resources available online that may be used to deliver this unit. Many of these offer simulations of genetic experiments that learners can carry out as well as animations to demonstrate and clarify genetic concepts. It is important that learners are guided through the vast quantity of internet resources available: many resources are aimed at genetic study at too high a level while others are simply not rigorously reviewed.

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Mammalian Genome
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www.hhmi.org/biointeractive/index.html	Howard Hughes Medical Institute
www.johnkyrk.com	Cell biology animations by John Kyrk
www.learn.genetics.utah.edu	University of Utah Genetic Science Learning Centre
www.molecularstation.com/science-videos	Molecular Station science videos and lectures
www.ncbe.reading.ac.uk	National Centre for Biotechnology Education
www.thenakedscientists.com	The Naked Scientists – science radio, podcasts and practical techniques

Unit 335 Chemistry for Biology Technicians

Level: 3

Credit value: 10

Unit aim:

This unit aims to provide learners with an understanding of the principles of chemistry for biology technicians and how these can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Be able to relate enthalpy changes to the bonding of a range of substances
2. Be able to show how rates of reaction are affected by varying the reaction conditions
3. Be able to interpret key features of equilibrium processes
4. Be able to demonstrate the structure and properties of simple organic molecules

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

N/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed SEMTA.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 335 Chemistry for Biology Technicians

Outcome 1 Be able to relate enthalpy changes to the bonding in a range of substances

Assessment Criteria

The learner can:

1. Carry out experiments to illustrate the relative magnitudes of the **enthalpy changes** associated with the formation and breakage of chemical **bonds**

Unit content

Enthalpy changes

First, second and third laws of thermodynamics. Enthalpy as an extensive property and a function of state. Enthalpy change diagrams and calculation, change in enthalpy for simple chemical reactions, stoichiometric calculations, measurement of heat capacity and specific heats. Hess's Law and standard enthalpies of formation. Enthalpy changes in ionic reactions, combustion and cellular respiration. Standard free energy change

Bonds

The formation and breakage of ionic, covalent and hydrogen bonds and the relevance of Van de Waals forces. Use of the periodic table to determine the structure of simple ionic and covalent compounds. Balancing of chemical equations

Unit 335 Chemistry for Biology Technicians

Outcome 2 Be able to show how rates of reaction are affected by varying the reaction conditions

Assessment Criteria

The learner can:

1. Carry out experiments to show the effect on the **rates of reactions** of changes in concentration, particle size, temperature and presence of a catalyst

Unit content

Rates of reactions

Measuring the rate of reaction: the instantaneous, initial, general and average rate of reaction. The rate law of reactions, rate constant and the method of initial rates. First, zero and second order reactions and their identification. Collision and transition state theories. Reaction profiles and calculation of enthalpy changes. Reaction mechanisms (elementary reactions, slow, fast and reversible steps). Homogenous and heterogeneous catalysts. Enzymes and the effect of temperature. pH, substrate/product concentrations and inhibition

Unit 335 Chemistry for Biology Technicians

Outcome 3 Be able to interpret key features of equilibrium processes

Assessment Criteria

The learner can:

1. Carry out an experiment on osmosis to demonstrate the drive towards the establishment of **equilibrium**
2. Outline how the acid dissociation constant , Ka, provides information about the extent to which **acids and bases** dissociate in aqueous solution
3. Construct half equations and redox equations for simple **redox reactions**

Unit content

Equilibrium

Dynamic nature of equilibrium, the equilibrium constant expression, and reaction quotient, kinetic and thermodynamic views of equilibrium. Le Châtelier's Principle. Calculation of the Equilibrium constant. Relationship of free energy change to the equilibrium constant. The effect of temperature and catalysts on the establishment of equilibrium

Acids and bases

Brønsted-Lowry theory, conjugate acid-base pairing, amphiprotic substances (including water), ionisation/dissociation constants, variation in strength of binary acids, oxoacids and carboxylic acids. Self ionisation of water and the pH scale, calculation of pH. Calculation of equilibrium in solutions of weak acids and weak bases, Buffers, capacity and range. Neutralisation and titration of a strong acid with a strong base and weak acid with a strong base. Effect of pH on amino acids and zwitter ion formation

Redox reactions

Principle of transfer of electrons in oxidation and reduction. Half reaction method of balancing redox equations, standard electrode potentials, spontaneous change and equilibrium in a voltaic cell. Criteria for spontaneous change in redox reactions. Balancing redox reactions.

Unit 335 Chemistry for Biology Technicians

Outcome 4 Be able to demonstrate the structure and properties of simple organic molecules

Assessment Criteria

The learner can:

1. Construct structural formulae for named examples of **simple organic compounds**, identifying structural, geometric, and optical isomers where appropriate
2. List typical properties of **simple organic compounds**

Unit content

Simple organic compounds

Short chain alkanes, alkenes, alcohols, alkyl halides, carboxylic acids, aldehydes, ketones, ethers, esters, amines, amides. Recognition of functional groups in organic molecules. Linear and ring structure of sugars and differentiation between aldehyde and keto sugars

Unit 335 Chemistry for Biology Technicians

Notes for guidance

This unit aims to provide learners with a grounding in key elements of organic, inorganic and physical chemistry that underpin the life sciences. It is envisaged that although the contents of this unit are necessarily broad they the outcomes will, wherever possible, be contextualised to the final qualification being undertaken.

Practical laboratory investigations are an important feature of this unit and as such learners will be aware and familiar with relevant safe working practices before any investigation is undertaken. It is imperative that learners gain practical experience in relevant calculations, drawing and identifying chemical structures and the process of scientific investigation including formulating hypotheses/performing a calculation, reporting results and evaluating their findings.

In Outcomes 1 and 2, learners will explore the energy changes associated with making and breaking chemical bonds and the effect of a series of variables on reaction rate. Although the delivery of underpinning theories will necessitate a degree of formal lecturing, practical investigative approached are strongly encouraged. Learners can measure enthalpy changes in exothermic and endothermic reactions using simple calorimetric apparatus and compare these to calculations that they have made. Simple calorimeters can be made using polystyrene cups or laboratory glassware. More accurate copper vessels are inexpensive and bomb calorimeters maybe purchased from educational suppliers at a further cost but are not required. Learners should become practiced at the required calculations and are encouraged to explore the opportunities for scientific discovery, reporting and evaluation provided throughout this unit.

Outcome 3 allows learners to explore the dynamics and significance of equilibrium equations. Again it is recognised that an element of formal lecturing will be required to deliver the underpinning theory involved in this. However, outcome 3 also allows the practical investigation in terms of the osmotic potential of the cell, a simple model of which may be created using semi-permeable tubing. Learners are encouraged to gain practical experience of calculating the equilibrium constant as well as those required when working with acids and bases. Titration experiments provide an excellent opportunity for learners to test their calculations as well as allowing them to produce their own titration curves and investigate the range and capacity of buffers.

In Outcome 4, learners will be required to identify and produce structural formulae for a range of simple organic molecules and identify different types of isomerism. Where possible, the content should be contextualised so that learners are aware of the industrial and commercial uses of key examples of each family of molecules. Ideally learners should, through the course of this unit, handle and explore the properties of selected examples, an example of which may be the effect of increasing length of the carbon chain on boiling point (and intermolecular forces) on alkanes and alcohols. Learners should have the opportunity to gain practice in drawing and identifying organic molecules and predicting the properties of simple examples based upon experimental findings.

Centres are encouraged to engage with employers and other institutions wherever possible and where possible these should be contextualised to the final qualification. The use and production of chemicals is so widespread within the life sciences that a wide range of engagement opportunities are available. These may include visits to farms, food processing and production industries, analytical and research laboratories, chemical and pharmaceutical industries and the petrochemical industry.

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Books

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Journal of Microbiology and Biology Education – American Society for Microbiology

New Scientist, Reed Business Information

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www.ncbe.reading.ac.uk	National Centre for Biotechnology Education
www.royalsociety.org	The Royal Society

Unit 336 Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of the principles of biochemistry and microbiology and how these can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

Learners will explore key processes that underpin life and investigate the lifecycle, hazards and benefits of a range of microorganisms.

Learning outcomes
There are **six** learning outcomes to this unit. The learner will:

1. Know the principles of biochemistry in relation to cellular structure and function
2. Understand the production of Adenosine Triphosphate (ATP) from glucose by aerobic and anaerobic respiration
3. Understand enzyme kinetics
4. Understand the growth and reproduction of bacteria, viruses and fungi
5. Know the hazards and uses of microorganisms
6. Be able to isolate and classify bacteria

Guided learning hours
It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards
N/a

Endorsement of the unit by a sector or other appropriate body
This unit is endorsed by Lantra SSC.

Assessment and grading
This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 336 Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology

Outcome 1 Know the principles of biochemistry in relation to cellular structure and function

Assessment Criteria

The learner can:

1. Describe the **structure** of **carbohydrates, proteins and lipids**
2. Outline the **function** of **carbohydrates, proteins and lipids** within an animal.

Range

Carbohydrates – monosaccharides, disaccharides, polysaccharides
Protein – amino acids, peptides, proteins
Lipids – triacylglycerols, fatty acids, cholesterol, phopholipids, waxes

Unit content

Structure of carbohydrates

Straight chain and ring structure of monosaccharides and condensation reactions to form 1-4 and 1-6 glycosidic bonds, combination of monosaccharides to produce common dissaccharides, reducing and non-reducing sugars, structures of glycogen, amylase and amylopectin

Structure of proteins

Common structure of an amino acid and significance of the 'R' group, condensation to form a peptide bond. Primary, secondary, tertiary and quaternary structures and the use of hydrogen bonds and disulphide bridges in forming these structures. Fibrous and globular proteins and denaturation

Structure of lipids

Structure of glycerol and fatty acids. Formation of a triacylglycerol from glycerol and three fatty acids. Structure of saturated and unsaturated fatty acids. Naming of fatty acids based upon both 'n' and Omega. Formation of phospholipids and their hydrophilic and hydrophobic properties

Function carbohydrates

Function of carbohydrates as energy stores, respiratory substrates and as structural components of animal and plant cells and tissues

Function of proteins

Function of proteins as respiratory substrates, storage molecules, enzymes, transport molecules (within the cell, across membranes and between cells), cell signalling molecules (hormones, receptors and signal transduction) and as structural components of animal and plant cells and tissues

Function of lipids

Functions of lipids as storage molecules, respiratory substrates, structural components of animal and plant cells and tissues, insulation, protection (e.g. waterproofing), buoyancy (e.g. blubber), cell membranes, and intercellular messengers (e.g. lipid based hormones)

Unit 336 Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology

Outcome 2 Understand the production of Adenosine Triphosphate (ATP) from glucose by aerobic and anaerobic respiration

Assessment Criteria

The learner can:

1. **Explain** the process of
    - **glycolysis**
    - **citric acid cycle**
    - **oxidative phosphorylation**
2. Compare **aerobic** and **anaerobic** respiration

Range

Cellular Glucose Metabolism: Glycolysis, Link Reaction, Citric Acid Cycle (Kreb's Cycle/Tricarboxylic Acid Cycle)

Oxidative Phosphorylation: Respiratory Chain/Electron Transport Chain, ATP Synthase, aerobic respiration, anaerobic respiration

Unit content

Glycolysis

The location of glycolysis in the cell, the principles of energy investment, Adenosine Triphosphate (ATP) use/production and final yield. The significance and production of NADH, pyruvate and water. The changes in chemical structure in terms of changes in the number of carbon atoms and the significance of changes in phosphorylation. The link reaction necessary to form acetyl-CoA from pyruvate

Citric Acid Cycle

The location of the cycle within the entry of acetyl-CoA into the cycle. The number of steps involved in each complete cycle and the changes in the number of carbon atoms as well as the steps that result in production of water, carbon dioxide, NADH, $FADH_2$, and GTP

Oxidative phosphorylation

The location of the electron transport chain and ATP synthase within the cell. The number of protein complexes and the significance of redox reactions, the transport of electrons and the movement of protons. The entry points for NADH and $FADH_2$ and the relative Adenosine Triphosphate (ATP) yields. The principle of proton motive force and the action of Adenosine Triphosphate (ATP) synthase

Aerobic and anaerobic respiration

Comparison of the ATP yield from each. Method of lactic acid production, energetic cost of lactic acid production and the conversion of lactic acid back to glucose, the principle of oxygen debt and the detrimental effects of excess lactic acid in animals

Unit 336 Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology

Outcome 3 Understand enzyme kinetics

Assessment Criteria
The learner can:
1. Evaluate models of enzyme **action**
2. Compare types of enzyme **inhibition**
3. Review the effect of **environmental changes** on enzyme reaction rates

Range

Action, inhibition and control of enzyme catalysed reaction in eukaryotic and prokaryotic cells

Unit content

Action
Lock and Key and Induced Fit models with reference to catabolic and anabolic enzyme reactions

Inhibition
Competitive, non-competitive, reversible and irreversible inhibition and their effect on the velocity of enzyme catalysed reactions

Environmental changes
pH, temperature, substrate and product concentration, and their effect on the velocity of enzyme catalysed reactions. The effect of denaturation on enzyme activity and causes of denaturation

Unit 336 Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology

Outcome 4 Understand the growth and reproduction of bacteria, viruses and fungi

Assessment Criteria

The learner can:

1. Compare the **reproduction** of microorganisms
2. Examine the **growth requirements** of microorganisms

Range

Bacteria, fungi and viruses

Unit content

Reproduction

Binary fission of bacteria, typical bacterial growth curve phases, sporulation (bacteria and fungi), transformation and transduction events, plasmids and their transfer by conjugation, budding. Viral adsorption, penetration, multiplication and release

Growth requirements

The effect of temperature, pH, osmotic variables, oxygen and nutrients. Use of growth requirements in bacterial selection and identification. Hyphae formation in fungi. Reliance of viruses on biochemistry of infected cell. The use of antiseptics, disinfectants, sterilisation (heat, radiation, filtration and chemical) and antibiotics to control microbial growth

Unit 336 Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology

Outcome 5 Know the hazards and uses of microorganisms

Assessment Criteria

The learner can:

1. Describe key **uses** of microorganisms with reference to animal and human health
2. Outline the relevance of **COSHH** legislation with reference to working with microorganisms
3. Identify **hazards** associated with handling microorganisms

Range

Bacteria, fungi, protozoa and viruses

Unit content

Uses

The use of fungi and bacteria in food technology to produce alcohol, foods such as cheese and leavened bread as well as vitamin and amino acid production. Production of high fructose corn syrup, vinegar, citric acid, silage, haylage and the importance of nitrogen fixation. The potential of genetic modification of microorganisms, a current example being insulin derived from bacterial sources. The role of microorganisms in animal digestion in the reticulo-rumen, coecum and large intestine

Control of Substances Hazardous to Health (COSHH) 2002

The application of COSHH to microorganisms including the classification of microorganisms based upon hazard and risk. The application of COSHH to chemicals commonly used in microbiological identification such as disinfectants, stains and solvents

Hazards

Infection/zoonosis, toxin production, environmental contamination, spore formation, aerosols formation. Hazards posed by commonly used equipment and chemicals in microbiological examination and identification such as naked flames, disinfectants, stains and solvents

Unit 336 Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology

Outcome 6 Be able to isolate and classify bacteria

Assessment Criteria

The learner can:

1. **Isolate** a monoculture from a mixed culture of bacteria under aseptic conditions
2. Use microbiological **tests to classify** a bacteria using a key

Range

Bacteria

Unit content

Isolate

Obtain a pure monoculture from a mixed culture of two or more species

Tests to classify

Use of a key to identify a monoculture of bacteria based upon the media composition, cellular metabolism, oxygen availability, colony morphology, motility, cell morphology and chemical staining properties

Unit 336 Understand the Principles and Carry Out the Practice of Biochemistry and Microbiology

Notes for guidance

This unit is designed to provide learners with an understanding of cell metabolism and microbiology as well as the importance of these to the life and well being of all animals.

Throughout the unit, the emphasis should be on safe working and the use of investigative methods. It is expected that learners will be aware of and familiar with safe laboratory working practices within the context in which they are working. This unit provides an opportunity for learners to develop not only general laboratory training but also to learn specific and valuable microbiological techniques currently used in industry and research.

In Outcome 1, the learner will be required to describe the structure-function relationships of a range of carbohydrates, proteins and lipids. Although it is accepted that formal lectures will play a role in delivering this outcome, it is recommended that an investigative practical laboratory approached is used where possible. Learners should be able to see and handle examples of different molecules and where possible compare and contrast their properties. For example learners might explore the physical properties of oils, fats and waxes and relate these to their chemical structure.

Outcome 2 is principally concerned with glucose metabolism by aerobic and anaerobic methods. This central pathway also provides an opportunity to explore the metabolism of both proteins and lipids as well as the role played by a range of vitamins and minerals in cell metabolism. Again it is accepted that formal lectures will be used during the delivery of this outcome, however there is scope for a more investigative approach. Yeast provides excellent models for aerobic and anaerobic respiration and learners themselves can be used to demonstrate the physiological effects of anaerobic respiration, which may then be related to the underlying biochemistry.

Outcome 3 explores the role of enzymes in cell metabolism and provides an excellent opportunity for learners to perform a practical investigation into enzyme kinetics. A range of plant and animal derived enzymes are available and a wide range of investigations may be derived from these. There are also a number of commercially available kits that may be used to investigate enzyme kinetics.

The delivery of Outcomes 4, 5 and 6 will involve a degree of formal lectures, though there is the opportunity to combine bacteriological aspects of Outcomes 4 and 5 into a practical microbiological investigation used to deliver Outcome 6. Learners should also have the opportunity to investigate the use of micro organisms in food production, which also provides an opportunity to learn about the reproduction and growth of fungi, for example in the production of wine, vinegar or blue cheese. The inhibition of bacterial growth may also be incorporated into the investigation involved in Outcome 6, for example through the use of disinfectant washes or antibiotic sensitivity testing discs.

Outcome 6 is designed to be delivered through a practical microbiological investigation whereby learners start with a mixed bacterial culture and are able to isolate and identify a monoculture using a simple bacterial key. CLEAPSS provides guidelines for working with micro organisms within education and many of the associated hazards can be avoided by purchasing ‘known’ non-pathogenic cultures. These may then be combined to produce a mixed culture that learners can work from. This investigation provides an opportunity for learners to gain experience of current industry techniques and acquire valuable practical skills.

Centres are encouraged to engage employers and other institutions wherever possible and this unit would benefit from any such engagement. Possible activities may include visits to research labs, food processing facilities and diagnostic facilities. It is worth noting that many publicly funded

research grants specify an obligation for public engagement and that it is envisaged that this unit may be particularly useful to learners wishing to progress to higher education.

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www.cleapss.org.uk	Consortium of Local Education Authorities for the Provision of Science Services
www.ase.org.uk	The Association for Science Education
www.ncbe.reading.ac.uk	National Centre for Biotechnology Education
www.sgm.ac.uk	Society for General Microbiology
www.sfam.org.uk	Society for Applied Microbiology
www.royalsociety.org	The Royal Society
www.biochemistry.org	The Biochemical Society

Unit 337 Understand the Principles of Chemistry for Biological and Medical Science

Level: 3

Credit value: 10

Unit aim

The aim of this unit is to enable learners to be familiar with basic chemical concepts which underpin biology and biomedical professions.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Be able to use the necessary skills to safely measure quantities for chemical reactions
2. Understand the effect of environmental conditions on rates of reaction
3. Understand the relationship between molecular bonding and enthalpy changes
4. Be able to interpret key features of equilibrium processes in fluid states

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

N/a

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 337 Understand the Principles of Chemistry for Biological and Medical Science

Outcome 1 Be able to use the necessary skills to safely measure quantities for chemical reactions

Assessment Criteria

The learner can:

1. Perform **volumetric calculations** leading to accurate chemical quantities required for reactions
2. Identify **hazards and controls associated with chemical reactions**
3. **Measure accurately** quantities of solid, liquid and gaseous chemicals

Unit content

Volumetric calculations

Avogadro's constant, calculations involving mass, moles, concentrations and volumes (e.g. M=CV, $M_aV_a = M_bV_b$), titration curves, units and interconversions (e.g. mol, dm^3, cm^3, mol dm^{-3}, g, $gmol^{-1}$)

Hazards and controls associated with chemical reactions

Laboratory safety symbol interpretation, Personal Protective Equipment (PPE), hazard identification and risk assessment

Measurement of solids, liquids and gases

Use of balances, measuring cylinders, burettes and gas syringes

Unit 337 Understand the Principles of Chemistry for Biological and Medical Science

Outcome 2 Understand the effect of environmental conditions on rates of reaction

Assessment Criteria

The learner can:

1. Summarise properties of elements, groups and rows in the Periodic Table, in terms of:
    - **structure**
    - **physical properties**
    - **chemical properties**
2. Describe **reaction mechanisms** and profiles
3. Identify **environmental conditions** that affect **rates of reactions**
4. Analyse the effect of environmental conditions on rates of reaction

Unit content

Structure, physical and chemical properties of chemicals

Atomic structure (neutrons, protons, electrons), electronic configuration and place in the Periodic Table, patterns in atomic radii, first ionisation energies, electronegativity, reactions of group 1, 2 and 4 elements with water, oxygen and chlorine, reactions of period 3 elements with water, oxygen and chlorine

Rates and mechanisms of reactions

Units of rate (mol $dm^{-3}s^{-1}$), collision theory, activation energy, reaction profiles, Maxwell-Boltzmann Distribution, simple reaction mechanisms (e.g. halogenalkanes and hydroxide ions), reactions with orders 0, 1 and 2, rate determining steps

Environmental conditions

Effect of concentration, temperature, pressure and addition of a catalyst to reactions, effect of pH, temperature and concentration of substrates on enzyme-catalysed reactions

Unit 337 Understand the Principles of Chemistry for Biological and Medical Science

Outcome 3 Understand the relationship between molecular bonding and enthalpy changes

Assessment Criteria

The learner can:

1. Explain ionic and covalent **bonding**
2. Analyse the **bonding** properties of **carbon**
3. Analyse **enthalpy changes** for endothermic and exothermic reactions
4. Apply Hess's Law to determine enthalpy changes in reactions

Unit content

Bonding

Ionic, covalent, hydrophilic/hydrophobic interactions, hydrogen bonds, Van der Waals forces

Bonding in carbon

Valences of carbon, structures of carbon compounds (straight, branched, ring), importance of carbon compounds in organisms (e.g. carbon dioxide, carbonate ions etc)

Enthalpy changes

Entropy, units (ΔH), standard enthalpy changes (combustion, formation, neutralisation and reaction) linked to bond formation and bond breakage, theory and application of Hess's law

Unit 337 Understand the Principles of Chemistry for Biological and Medical Science

Outcome 4 Be able to interpret key features of equilibrium processes in fluid states

Assessment Criteria

The learner can:

1. **Calculate pH values** from proton concentrations and vice versa
2. Analyse **equilibria of liquids and gases** across membranes
3. Predict **shifts in equilibrium** due to:
    a. concentration
    b. temperature
    c. pressure
4. Describe **reduction and oxidation** processes in biological systems

Unit content

pH calculations

Hydrogen ion concentration in aqueous solutions, K_w, Henderson-Hasselbalch equation, $pH = {}_{log10}[H+]$, $[H+]=10^{-pH}$

Equilibria of liquids and gases

Diffusion, osmosis, water potential, membrane potential, oxygen-haemoglobin dissociation curve, blood serum analysis and indicators of common disorders in one relevant species

Shifts in equilibrium

Reversible reactions, Le Chatelier's Principle, calculation of equilibrium constant, effects of changing concentration, temperature and pressure on the position of equilibrium

Reduction and oxidation

Oxidation, reduction, oxidising and reducing agents, oxidation numbers for organic compounds, redox reactions of ATP in respiration, action of oxidoreductases, redox processes in digestion

Unit 337 Understand the Principles of Chemistry for Biological and Medical Science

Notes for guidance

This unit should be delivered in a varied fashion, using tutorials, problem solving and practical investigations alongside formal lectures and practice. Animations and games are available on the internet for use by learners or within teaching sessions. Learners should be given vocationally relevant contexts wherever possible and biological examples should be used to illustrate the relevance of the chemistry throughout.

Tutors must ensure that learners are aware of hazards involved in laboratory work, and that learners have appropriate personal protective equipment before commencing any practical investigations. Learners could begin practical work with putting together risk assessments specific to the laboratory in which the investigations are taking place, and would benefit from being able to see risk assessments produced by working laboratories. If possible, learners should be able to visit diagnostic laboratories and guest lectures by biomedical scientists are encouraged.

The preclinical curriculum for veterinary and biomedical sciences has biochemistry and physiology as core components. It is important that learners understand basic chemical concepts in order to go on to study these subjects at a higher level, as well as understanding the importance of chemical understanding within a biological context.

One of the most useful diagnostic tools available to biomedical practitioners is blood analysis. Though part of this will involve the study of blood cells (haematology) a significant proportion involves analysis of substances in the blood serum, such as sodium, potassium and chloride levels, and blood urea, nitrogen and ammonia. The values of these results can be presented in different units and therefore an understanding of the units, and the ability to convert to different units, is essential.

Accurate interpretation of blood serum analysis requires chemical knowledge in areas such as behaviour of elements / molecules and the periodic table, chemical reactions and kinetics, quantitative chemistry and disassociation of acids and bases.
The unit contains practical mathematics and tutors are strongly encouraged to build learners' confidence in more basic mathematical techniques prior to introducing the more advanced mathematics.

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New Scientist
Pure and Applied Chemistry

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	chemistry-react.org Nuffield Advanced Chemistry
www.chemguide.co.uk	Chemguide (Jim Clark)
www.cleapps.org.uk	CLEAPPS
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www.practicalchemistry.org	Practical Chemistry (Nuffield Foundation Curriculum Programme / Royal Society of Chemistry / CLEAPPS)
www.rsc.org	Royal Society of Chemistry
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Unit 338 Understand and Carry Out Farm Livestock Husbandry

Level: 3

Credit value: 10

Unit aim:

This unit aims to provide learners with an understanding of the principles of farm livestock husbandry and how these can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

The aim of this unit is to develop the learner's knowledge and skills required for the successful care and management of farm livestock. The learner will be able to handle farm livestock in order to carry out specific husbandry techniques. The learner will understand the accommodation and environmental requirements of farm livestock and how to prepare suitable rations according to need.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Understand the production systems for farm livestock
2. Be able to carry out handling techniques for farm livestock
3. Understand the environmental conditions required for farm livestock
4. Understand the feed and water requirements for farm livestock

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

LP24 Establish, monitor and maintain appropriate conditions for livestock

LP25.2 Deliver routine husbandry procedures

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- An assignment covering practical skills and underpinning knowledge

Unit 338 Understand and Carry Out Farm Livestock Husbandry

Outcome 1 Understand the production systems for farm livestock

Assessment Criteria

The learner can:

1. Explain the use of different **breeds** of common farm livestock in production systems
2. Evaluate **production systems** for common farm livestock.

Range

This unit can cover any suitable livestock, for example farm animals, such as pigs, cattle, poultry, pigs and sheep or large mammals such as goat, camelids, donkeys, or other available large mammals

Unit content

Breeds

Commercial breeds, native and imported breeds of dairy and beef cattle, native and imported breeds of pure breed and cross breed sheep, pigs (hybrids and pure bred), poultry (hybrids and pure breeds), rare breeds, uses of (e.g. milk, meat and egg production systems)

Production systems

Cattle (beef and dairy), sheep (meat and wool), pigs (meat and breeding stock), poultry (meat and eggs), type of production system (indoor, outdoor), intensive, organic, free range length of time animal is in system, slaughter age

Unit 338 Understand and Carry Out Farm Livestock Husbandry

Outcome 2 Be able to carry out handling techniques for farm livestock

Assessment Criteria

The learner can:

1. Carry out animal **health checks** prior to handling farm livestock
2. Select appropriate **equipment** to be used when carrying out **handling** techniques for farm livestock
3. **Handle farm livestock safely** in a way that complies with relevant legislation, minimises stress and injury
4. Complete animal **movement records** appropriately

Range

This unit can cover any suitable livestock, for example farm animals, such as pigs, cattle, poultry, pigs and sheep or large mammals such as goat, camelids, donkeys, or other available large mammals

Unit content

Health checks

Visual signs: condition of coat/feathers, eyes, ears, skin, mucous membranes, appetite, water intake, faeces and urine output, lameness and limb movement, coughing and choking, discharges and weight changes, behaviour (restlessness, posture, movements, relation to other animals)

Handling equipment

Handling equipment (head collars, ropes and halters, races, crush and bull rings),
choice of equipment according to situation

Handling farm livestock safely

Reasons for handling, restraint and movement of farm livestock (moving from one field to another, bringing indoors, turning out into field, health checks, administering treatments and preventative care, foot trimming, tagging, shearing, weighing), handle and move livestock safely, risk assessments, Personal Protective Equipment (PPE) (overalls, boots and gloves), the importance of moving large animals without handling and in all cases the avoidance of stress

Movement records

Documentation: correct completion, role of the Department for Environment, Food and Rural Affairs DEFRA (England), Welsh Assembly Government (Wales), Scottish Executive Environment and Rural Affairs Department SEERAD (Scotland) Department of Agriculture and Rural Affairs (DARD) NI, in keeping and maintenance of livestock movement records

Unit 338 Understand and Carry Out Farm Livestock Husbandry

Outcome 3 Understand the environmental conditions required for farm livestock

Assessment Criteria

The learner can:

1. Explain the accommodation requirements of **indoor reared** farm livestock
2. Explain the accommodation requirements of **outdoor reared** farm livestock
3. Discuss the **routine maintenance** of farm livestock accommodation

Range

This unit can cover any suitable livestock, for example farm animals, such as pigs, cattle, poultry, pigs and sheep or large mammals such as goat, camelids, donkeys, or other available large mammals

Unit content

Indoor reared

Ventilation, insulation, flooring, drainage, lighting, temperature, space allowance
Relevant current codes of practice, Animal Welfare Act 2006, Health and Safety at Work 1974

Outdoor reared

Shelters, boundaries, hedges, management of grassland
Relevant current codes of practice, Animal Welfare Act 2006, Health and Safety at Work 1974

Routine maintenance

Maintenance of accommodation: bedding, disinfection and cleaning routines, safety and security of livestock, Personal Protective Equipment (PPE), safe handling and disposal of waste (hazardous and non-hazardous)
Legal requirements e.g. Environmental Protection Act 1990 (as amended 1995), disposal of fallen stock

Unit 338 Understand and Carry Out Farm Livestock Husbandry

Outcome 4 Understand the feed and water requirements of farm livestock

Assessment Criteria

The learner can:

1. Explain the suitability of **feed rations** according to purpose and life stage of common farm livestock
2. Explain the correct storage and **preparation** of **feed and water** for common farm livestock

Range

This unit can cover any suitable livestock, for example farm animals, such as pigs, cattle, poultry, pigs and sheep or large mammals such as goat, camelids, donkeys, or other available large mammals

Unit content

Feed rations

Type: (dry/wet, concentrates, crops, silage, hay, supplements), quantity of feed according to production, life stage and health status (e.g. weaning, pregnant, lactating, adult, ill, purpose of animal), quality of feed (best before dates, stock rotation). Nutrient content of ration e.g. protein, carbohydrate, fats, vitamins and minerals

Feed and water preparation

Storage of feed: containers, insect and rodent infestations and mould, prepare food according to instructions, checking water is fresh and clean

Unit 338 Understand and Carry Out Farm Livestock Husbandry

Notes for guidance

This unit is designed to provide the learner with the knowledge and skills required to work with and manage farm livestock. The unit should cover a range of animals from the list below. This unit should be delivered in conjunction with a working farm or relevant work experience placement, which would ensure that the learner experienced routine farm activities on a regular basis and would experience the 'farming year' (e.g. mating, lambing).

This unit can cover any suitable livestock, for example farm animals, such as pigs, cattle, poultry, pigs and sheep or large mammals such as goat, camelids, donkeys, or other available large mammals.

Throughout the unit emphasis should be placed on safe working. It is expected that learners will be aware of safe working practices and be familiar with accepted practices and behaviours within the context in which they are working.

Outcome 1 is likely to be delivered by formal lectures and visits to animal farms, particularly those with rare breeds. Learners will be expected to research different breeds of farm livestock and the systems used to produce them.

In Outcome 2, learners are required to handle, restrain and move farm livestock. Through practical activities, learners will develop skills in assessing the visual and behavioural signs of health in animals and select, use and maintain equipment appropriately. Learners should be encouraged to handle a range of farm livestock, with the emphasis on safe working and dealing with animals in a way which reduces stress and minimises injury to the learner, animals and others. Learners will also be required to complete animal movement records.

Outcome 3 is likely to be delivered by formal lectures and practical activities. Learners will be required to explain the different environmental conditions that should be provided for indoor and outdoor reared livestock. Learners are required to discuss the hygiene and maintenance needs of farm livestock. The delivery of this unit will be enhanced by appropriate practical activities, for example the preparation and routine maintenance of livestock accommodation.

In Outcome 4, learners will be required to provide feed and water for farm livestock. The delivery of this outcome will involve formal lectures and practical activities.

Centres are encouraged to introduce employers and specific professionals from industry to provide interesting and relevant information to the learner. Teaching would also benefit from visits to a variety of establishments to add depth to the learner experience.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is recommended that they are directly linked to interactive sessions in a real environment. Learners must be given the opportunity to deal with a range of animals in different situations which reflects current industry practice.

References

Books

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www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)

Unit 339 UNDERTAKING AGRICULTURAL COMBINABLE CROP PRODUCTION

Level: 3

Credit value: 10

Unit aim

This unit aims to introduce learners to the skills, knowledge and understanding needed for agricultural combinable crop production and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Know how to establish combinable crops
2. Be able to plan the management of combinable crops
3. Understand how to harvest and store combinable crops
4. Understand combinable crop production costs and markets

Guided learning hours

It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Agriculture National Occupational Standards.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by Lantra SSC.

Assessment and grading

This unit will be assessed by:

- an assignment covering practical skills and underpinning knowledge.

Unit 339 UNDERTAKING AGRICULTURAL COMBINABLE CROP PRODUCTION

Outcome 1 Be able to isolate and classify bacteria

Assessment Criteria

The learner can:

1. identify appropriate crops and varieties
2. select appropriate equipment for seedbed preparations
3. describe establishment methods for selected crops including:
    - choice of site
    - soil management
    - sowing method

Unit 339 UNDERTAKING AGRICULTURAL COMBINABLE CROP PRODUCTION

Outcome 2 Error! No text of specified style in document.

Assessment Criteria

The learner can:

1. plan a fertiliser programme for named crops
2. describe weed, pest and disease control procedures appropriate to production of a named crop
3. describe correct legislative and environmental guidelines relevant to named crops

Unit 339 UNDERTAKING AGRICULTURAL COMBINABLE CROP PRODUCTION

Outcome 3 Error! No text of specified style in document.

Assessment Criteria

The learner can:

1. explain harvesting operations for named crops
2. discuss suitable storage conditions for a named crop
3. evaluate control methods of storage pests and diseases

Unit 339 UNDERTAKING AGRICULTURAL COMBINABLE CROP PRODUCTION

Outcome 4 Error! No text of specified style in document.

Assessment Criteria

The learner can:

1. evaluate market requirements for given combinable crops
2. analyse crop yields
3. compare market prices and production costs for different crops

Unit 340 Land-based Engineering Operations – Service and Repair Engines and Components

Level: 3

Credit value: 10

Unit aim

This unit aims to provide learners with an understanding of servicing and repairing engines and components and how these can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

The aim of this unit is to provide the learner with the knowledge, understanding and skills required to perform service and repair procedures on engines within land based engineering.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will be able to:
1. Perform service and repair procedures on engines and their components
2. Identify engine faults
3. Understand how to analyse and interpret findings from engine inspections and rectify
4. Understand how to take engine measurements

Guided learning hours
It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards
This unit is linked to the 029NLEO11.

Endorsement of the unit by a sector or other appropriate body
This unit is endorsed by Lantra SSC.

Assessment and grading
This unit will be assessed by:
- An assignment covering practical skills and underpinning knowledge.

Unit 340 Land-based Engineering Operations – Service and Repair Engines and Components

Outcome 1 Perform service and repair procedures on engines and their components

Assessment Criteria
The learner can:
1. Prepare, **inspect** and record the **condition of engines** and their **components**
2. Use correct **measuring equipment** to verify compliance of **engine components**
3. Investigate failed or worn parts and record and **report findings**

Range

Engines
Spark ignition (S I) and Compression Ignition (C I) engines (four stroke and two stroke) (air and water cooled)

Unit content

Inspect
Visual, audible, measurement

Condition of engine
How the engine and its components visually appear during the inspection verified

Measuring equipment
Flat surface, Micrometer, dial gauge, compression gauge, Plastigage, feeler gauges, bore gauge

Engine components
Cylinder block components (engine block, crankshaft, connecting rods, pistons, piston rings), cylinder liners (wet, dry), timing drives, flywheel, balancer units, cylinder head components (cylinder head, head gasket, valve guides, inlet and exhaust manifolds), valve train (camshaft, cam followers),pushrods, rocker shaft, rocker arms, valves, valve springs, valve rotators

Report findings
Select report format (table, pictorial report, written report, and diagram) to show the condition of the engine and its components, including reasons for any failure

Unit 340 Land-based Engineering Operations – Service and Repair Engines and Components

Outcome 2 Identify engine faults

Assessment Criteria
The learner can:
1. Carry out **tests** to determine the cause of different **engine problems**
2. Set and adjust **engine performance** within **specified limits**
3. Identify and rectify engine system **faults**

Range

Engines
Spark ignition (S I) and Compression Ignition (C I) engines (four stroke and two stroke) (air and water cooled)

Unit content

Tests
Compression, engine power/torque, fuel consumption, fuel/oil pressure, visual, audible, Information and Communications Technologies (ICT), emissions, road test, methods used to analyse test data, use of testing equipment, for example dynamometer, compression cylinder leakage tester, fuel injection testing equipment, engine oil pressure and temperature gauges, coolant system leakage testers, exhaust gas analysis

Engine problems
Poor running, excessive fuel/oil consumption, low power, poor performance, misfire, backfire, incorrect engine oil pressure, incorrect engine temperature, seizure, abnormal noise, non starting, excessive engine breathing, engine system pressure abnormalities, excessive fuel use, incorrect timing, excessive emissions, incorrect fuel/air mixture, poor cold starting

Engine performance
Power, torque, Revs Per Minute (RPM), fuel use, emissions

Specified limits
Manufacturers' instructions, health and safety, current legislation, risk assessments

Faults
Faults relating to mechanical systems for example engine, transmission, steering, suspension, brakes, air conditioning, electrical systems for example starting, charging, lighting, auxiliary, instrumentation, electronic systems for example driver information, engine management, headland management, sensors, Engine Control Units (ECU), hydraulic systems for example pumps, valves, filters, linkages, clutch packs

Unit 340 Land-based Engineering Operations – Service and Repair Engines and Components

Outcome 3 Understand how to analyse and interpret findings from engine inspections and rectify

Assessment Criteria
The learner can:
1. Describe how to identify and rectify the cause of **engine problems**
2. Explain the **methods of sealing combustion chambers, fuel and ignition systems**
3. Describe the **effects** of moisture and contaminates in fuel and ignition systems
4. Explain the procedure to verify correct engine timing covering both static and dynamic timing

Range

Engines
Spark ignition (S I) and Compression Ignition (C I) engines (four stroke and two stroke) (air and water cooled)

Unit content

Engine problems
Poor performance, misfire, backfire, incorrect engine oil pressure, incorrect engine temperature, seizure, abnormal noise, non starting, excessive engine breathing, engine system pressure abnormalities, excessive fuel use, incorrect timing, excessive emissions, incorrect fuel/air mixture, poor cold starting, restricted intake/exhaust flow

Methods of sealing combustion chambers, fuel and ignition systems
Head gasket, valves, valve stem seal, valve seats, piston rings, fuel pipes, sealed fuel tanks, breathers, sealed ignition systems

Effects
Non Starting, poor running, misfire, poor acceleration

Unit 340 Land-based Engineering Operations – Service and Repair Engines and Components

Outcome 4 Understand how to take engine measurements

Assessment Criteria
The learner can:
1. Describe the methods and techniques of taking engine specific **measurements**

Range

Engines
Spark ignition (S I) and Compression Ignition (C I) engines (four stroke and two stroke) (air and water cooled)

Unit content

Measurements
Piston ring gap, cylinder ovality, cylinder protrusion, cylinder liner/bore ovality and taper, crankshaft end float and journal ovality, piston/head clearance, valve and valve operating system clearance, cylinder head flatness, ancillary component within specification

Unit 340 Land-based Engineering Operations – Service and Repair Engines and Components

Notes for guidance

This unit is designed to provide learners with knowledge and understanding of how to service and repair engines and related components of land-based power units and equipment to be found in their area of study, identify common engine faults, analyse and interpret findings from engine inspections, including measuring engines and related components. At all times when practical tasks are carried out or assessed, an emphasis must be put on safe working practices and current legislation.

Centres and tutors need to be aware of the need to safeguard learners, when delivering and assessing units where the maintenance of equipment and machinery is involved. This unit requires the learner to undertake machinery maintenance under close supervision. Throughout delivery of the unit the emphasis should be on acceptable health and safety procedures and safe working practices. The guidance in this unit requires that Health and Safety must be strictly enforced and repeated throughout.

In Outcome 1, delivery is likely to include a large practical content, which may include demonstrations and supervised practical workshop sessions. The learner will gain practical skills in inspecting the condition of engines, recording the results, and comparing the recorded results with the correct specifications. It is important that delivery also covers the identification and use appropriate tools to measure these engine components, as well as investigating failed/worn components.

In Outcome 2, delivery is also likely to be highly practical in nature. Learners will need sufficient supervised practical workshop sessions to enable them to identify common engine faults. This will involve testing, adjusting and rectifying engine faults. Part of this will require working on running machinery, so emphasis should be directed to safe working practices. It is important that all work is completed in line with manufacturers' specifications.

Delivery of Outcomes 3 and 4 provides the underpinning knowledge and understanding for the practical activity in Outcomes 1 and 2, so it is important that close links are made.

In Outcome 3, the learner will gain an understanding of how to identify and rectify the causes of common engine faults. It would be beneficial for delivery to include use of case study material, providing learners with a range of diagnostic test results and enabling them to develop the skills to recognise the potential engine problems. Learners will also gain an understanding of the methods of sealing combustion chambers, fuel and ignition systems, the effects of moisture and contaminates in fuel and ignition systems and the procedure to verify correct engine timing. Delivery is likely to be predominantly through classroom based activities, supported by practical demonstrations and linked to Outcomes 1 and 2.

In Outcome 4 the learner will learn the correct method and technique for taking specified measurements on an engine, including the importance of correct and accurate measurement, using the correct apparatus for measurement, and ensuring the measurement is taken to the correct accuracy. Delivery is likely to include classroom based activity together with practice of taking correct measurements using a range of testing equipment.

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www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.hse.gov.uk	Health and Safety Executive
www.howstuffworks.com	How Stuff Works
www.iagre.org	Institution of Agricultural Engineers

Unit 341 Understanding and Servicing Land-based Machines (Cultivation and Planting Equipment)

Level: 3

Credit value: 10

Unit aim

This unit aims to introduce learners to the skills and knowledge involved in the construction, operation and servicing of machines designed to prepare seedbeds and plant seeds and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will:
1. Understand the operation and function of land-based cultivation and planting machines
2. Be able to carry out routine service and non routine maintenance to land-based cultivation and planting machines
3. Be able to carry out inspection and overhaul procedures on land-based cultivation and planting machines
4. Understand how machines produce different seedbeds to cater for different crops and planting techniques

Guided learning hours
It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards
This unit is linked to the Land-based Service Engineering NOS.

Endorsement of the unit by a sector or other appropriate body
This unit is endorsed by Lantra SSC.

Assessment and grading
This unit will be assessed by:
- An assignment covering practical skills and underpinning knowledge.

Unit 341 Understanding and Servicing Land-based Machines (Cultivation and Planting Equipment)

Outcome 1 Understand the operation and function of land-based cultivation and planting machines

Assessment Criteria
The learner can:
1. Compare the **function** of a given range of **cultivation and planting machines**
2. Explain the **operating principles** of a range of cultivation and planting machines
3. Evaluate a range of available machines which have similar **functions** but use different operating principles

Unit content

Function
What the machine does (cut chop smash squash, spread, and sow) and how it does it, (tines discs, coulter types, broadcasters metering units), operational width

Cultivation and planting machines
Cultivation machinery: Powered, non powered cultivation equipment including primary and secondary (subsoilers and mole ploughs, mouldboard ploughs, disc harrows, rigid tine cultivators, spring tine cultivators, seed harrows, arable rolls and presses (single and double), powered cultivators e.g. vertical rotor harrows, horizontal rotor harrows)
Planting machinery: seed drills, combination drills, precision planters (mechanical and pneumatic), transplanters

Operating principles
Tine angle, tine type depth control
Disc shape, size, function and angle, depth control
Consolidation, roll, wheel, position, weight transfer, ground following
Mouldboard size shape, skimmers, depth control

Functions
Drilling, planting, cultivation, consolidation or a combination of all/some of these

Unit 341 Understanding and Servicing Land-based Machines (Cultivation and Planting Equipment)

Outcome 2 Be able to carry out routine service and non routine maintenance to land-based cultivation and planting machines

Assessment Criteria

The learner can:

1. Carry out **routine service** tasks to a given **range of machines** in accordance with manufacturers schedules
2. Carry out **non routine maintenance** tasks to a given range of machines which are not outlined in manufacturers service schedules
3. Discuss the **consequences** on the performance of cultivation and planting machines that have not been subjected to adequate service and maintenance

Unit content

Routine service

Daily, weekly seasonal services as laid down in the machines operator's manual

Range of machinery

Powered, non powered cultivation equipment, drilling and planting machinery

Non routine maintenance

Breakdowns, malfunctions and upgrade work

Consequences

Component failure, unsatisfactory operation, reduced output, downtime

Unit 341 Understanding and Servicing Land-based Machines (Cultivation and Planting Equipment)

Outcome 3 Be able to carry out inspection and overhaul procedures on land-based cultivation and planting machines

Assessment Criteria
The learner can:
1. Produce **condition report**s on a given **range of cultivation and planting machines**
2. Carry out **distortion and alignment** checks on a given range of cultivation and planting machines
3. Carry out **overhaul procedures** to a given range of cultivation and planting machines

Unit content

Condition report
Verbal, visual or written report on state of repair of machinery

Range of cultivation and planting machines
Powered, non powered cultivation equipment, drilling and planting machinery

Distortion and alignment
Visual, measuring

Overhaul procedures
Lubrication, routine service, replacing wearing parts

Unit 341 Understanding and Servicing Land-based Machines (Cultivation and Planting Equipment)

Outcome 4 Understand how machines produce different seedbeds to cater for different crops and planting techniques

Assessment Criteria
The learner can:
1. **Prepare** a given **range of cultivation and planting machines** for work
2. **Operate and adjust** a given range of machines to achieve given **objectives**
3. Evaluate the **quality of work and work rates** of a given range of cultivation and planting machines when subjected to different settings and conditions

Unit content

Prepare
Set up as per operator's instruction book

Range of cultivation and planting machines
Powered, non powered cultivation equipment, drilling and planting machinery

Operate and adjust
Use the machinery as per the operator's instruction manual, and adjust to gain satisfactory results

Objectives
Cultivation objectives: to prepare the soil at the required depth into the required size to meet the needs of the next operation
Planting objectives: to place the seed at the correct depth, spacing and with correct soil coverage to give germination

Quality of work and work rates
Cultivation: depth, finish, clod size, speed, width of machine.
Planting: consistency of seed placement, seed spacing, seed coverage, width of planting, speed of planting

Unit 341 Understanding and Servicing Land-based Machines (Cultivation and Planting Equipment)

Notes for guidance

This unit allows the learner to understand the function and operation of cultivation and planting equipment, be aware of the need for, and carry out routine inspection, service and overhaul. The Learner will also learn how to set up, operate and evaluate a full range of planting and cultivation equipment.

For all the outcomes a full range of machinery must be available to the learner to include: conventional, combination and pneumatic drills, precision planting machines of relevant types, sub-soilers and mole ploughs, mouldboard ploughs, disc harrows, rigid tine cultivators, spring tine cultivators, seed harrows, arable rolls and presses and powered cultivators (power harrows, rotavators.) Attention should be brought to the multi functional machinery that combines functions of two or more of these machines (e.g. Simba Solo, Vaderstad Rapid A drill/Topdown cultivator, Horsch Sprinter drills).

Centres and tutors need to be aware of the need to safeguard learners when delivering and assessing units where the operation of equipment and machinery is involved. This unit requires the learner to undertake thermal joining and cutting operations under close supervision. There is significant emphasis on safe practices throughout the unit. Throughout the unit the emphasis should be on acceptable health and safety procedures and safe working practices. The guidance in this unit requires that Health and Safety must be strictly enforced and repeated throughout.

Outcome 1 allows the learner to compare a range of cultivation and planting machinery, from a full range of machinery. The learner must learn operating principles of the equipment, and be aware of different machines that are capable of the producing the same or very similar results (e.g. discs and drags). This is a mainly classroom base unit, but examples drill coulters, metering units, cultivation tines discs and points must be available for demonstration and discussion.

Outcome 2 allows the learner to carry out routine and non routine servicing, in order to carry this out a range of replacement and service parts must be available. The learner must also discuss either written or verbally with the tutor, the consequences of poor service and maintenance, in the performance and financial terms. This unit is workshop based and requires well planned practical's to ensure the learner has full understanding of the subject.

Outcome 3 looks at inspection and checks (for wear, distortion and damage). This unit can be run in conjunction with Outcome 2 as the inspection of machinery and servicing tend to go hand in hand.

Outcome 4 looks at the operation and in work adjustment of planting and cultivation equipment. A range of ground conditions and types should be used. Guidance should be given to the learner to help with machine adjustment, to meet the operation requirements. If certain machines are not available, a visit to a local or national demonstration such as Tillage may be appropriate, or a local farm with the relevant machine.

Outcomes 2, 3 and 4 are mainly workshop practical based. Throughout the unit the emphasis is on acceptable health and safety procedures and safe working practices

References

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www.hse.gov.uk	Health and Safety Executive
www.howstuffworks.com	How Stuff Works
www.iagre.org	Institution of Agricultural Engineers

Unit 342 Understanding and Servicing Land-based Harvesting Machinery (Cutting and Lifting)

Level: 3

Credit value: 10

Unit aim

The aim of this unit is to provide the learner the understanding required for the maintenance and repair of cutting and lifting mechanisms of harvesting machinery and how these can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will:
1. Understand the principles of crop cutting and lifting in land based harvesting machinery
2. Be able to carry out 'preparation for work' procedures on crop cutting and lifting mechanisms in harvesting machinery
3. Be able to carry out maintenance, repair and 'out of season lay up' procedures on crop cutting and lifting mechanisms in harvesting machinery
4. Understand the 'control of' and specification of crop cutting and lifting mechanisms in harvesting machinery

Guided learning hours
It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards
This unit is linked to the Land-based Service Engineering NOS.

Endorsement of the unit by a sector or other appropriate body
This unit is endorsed by Lantra SSC.

Assessment and grading
This unit will be assessed by:
- An assignment covering practical skills and underpinning knowledge.

Unit 342 Understanding and Servicing Land-based Harvesting Machinery (Cutting and Lifting)

Outcome 1 Understand the principles of crop cutting and lifting in land based harvesting machinery

Assessment Criteria
The learner can:
1. Explain the principles of crop cutting and lifting in **harvesting machinery**
2. Explain how **cutting** and **lifting mechanisms** accommodate varying **crops** and **crop conditions**

Range

Harvesting machinery
Cereal, green crop harvesters, root crop harvesters, timber harvesters

Unit content

Cutting mechanisms
Rotary, reciprocating and oscillating

Lifting mechanisms
Belts, augers, rollers, shares elevators, wheels

Crops
Cereal, green crops, root crops, timber

Crop conditions
Damp, dry, standing, laid, sparse, dense

Unit 342 Understanding and Servicing Land-based Harvesting Machinery (Cutting and Lifting)

Outcome 2 Be able to carry out 'preparation for work' procedures on crop cutting and lifting mechanisms in harvesting machinery

Assessment Criteria
The learner can:
1. Carry out adjustments to enable **crop cutting** and **lifting mechanisms** to give **optimal performance** in a range of crops and **crop conditions**

Range

Harvesting machinery
Cereal, green crop harvesters, root crop harvesters, timber harvesters

Unit content

Cutting mechanisms
Rotary, reciprocating and oscillating

Lifting mechanisms
Belts, augers, rollers, share elevators, wheels

Optimum performance
As set out in manufacturers guidance and advice, as required by further processing, storage or customer requirements, appropriate to crop, weather and ground conditions

Crop conditions
Damp, dry, standing, laid, sparse, dense

Unit 342 Understanding and Servicing Land-based Harvesting Machinery (Cutting and Lifting)

Outcome 3 Be able to carry out maintenance, repair and 'out of season lay up' procedures on crop cutting and lifting mechanisms in harvesting machinery

Assessment Criteria
The learner can:
1. Carry out **maintenance procedures** on crop **cutting and lifting mechanisms**
2. Carry out **procedures** to identify and **rectify faults** on crop cutting and lifting mechanisms
3. Carry out '**out of season lay up**' procedures to crop cutting and lifting mechanisms

Range

Harvesting machinery
Cereal, green crop harvesters, root crop harvesters, timber harvesters

Unit content

Cutting mechanisms
Rotary, reciprocating and oscillating

Lifting mechanisms
Belts, augers, rollers, shares elevators, wheels

Maintenance procedures
As specified in manufacturers guidance, workshop manuals, operator manuals
Maintenance can be daily, short term or long term

Procedures
As specified by machine manufacturers

Faults
Major, minor, harvesting

Rectify
Carry out the necessary procedures to unable the machine to operate correctly

Out of season lay up
The processes required to ensure that the machine is left in a safe and suitable condition to be stored for the out of season period: cleaning and servicing, corrosion prevention, protection from weather, protection from vermin

Unit 342 Understanding and Servicing Land-based Harvesting Machinery (Cutting and Lifting)

Outcome 4 Understand the 'control of' and specification of crop cutting and lifting mechanisms in harvesting machinery

Assessment Criteria
The learner can:
1. Explain the operator **control procedure**s of crop cutting and lifting mechanisms
2. Explain the **specification** data of crop cutting and lifting mechanisms

Range

Harvesting machinery
Cereal, green crop harvesters, root crop harvesters, timber harvesters

Unit content

Control procedures
Procedures available to the operator to influence the performance of the cutting and lifting mechanism

Specification
As laid down the machine manufacturer in operator's manuals, workshop manuals and technical bulletins

Unit 342 Understanding and Servicing Land-based Harvesting Machinery (Cutting and Lifting)

Notes for guidance

This unit is designed to provide the learner with a sound understanding and the necessary skills to be able to prepare the machines for work and carry out maintenance, repair and out of season lay up on machines appropriate to their work context.

Throughout the unit the emphasis must be on safe working practices. The learner will be expected to work with recognised industry standards and be familiar with the requirements of risk assessments required for the tasks undertaken. This will include the use of service manuals as appropriate.

Centres need to be aware of the need to safeguard learners, when delivering and assessing units where the maintenance of equipment and machinery is involved. This unit requires the learner to undertake machinery maintenance under close supervision. Throughout delivery of the unit the emphasis should be on acceptable health and safety procedures and safe working practices. The guidance in this unit requires that Health and Safety must be strictly enforced and repeated throughout.

Delivery could take the form of classroom based sessions, workshop practical sessions, work placement evaluation and assessment of the systems performance. The use of visiting speakers may also be considered to assist with the delivery.

All learners will be expected to use machines of similar complexity to allow fairness of assessment.

For Outcome 1 the learner will need to explain the principles of crop cutting and lifting for harvesting machines. The learner will also need to explain how the cutting and lifting mechanisms chosen accommodate varying crops and crop conditions.

For Outcome 2 learners will need to carry out the adjustments necessary for preparing the cutting and lifting mechanisms for work to give optimal performance for difference crops and crop conditions, different cutting types and lifting mechanisms. The optimal performance must give consideration to the areas identified in the unit content.

For Outcome 3 learners will need to carry out maintenance and repair procedures for different cutting and lifting mechanisms. The procedures followed will be those required by the crop, soil, weather conditions or a s prescribed by the equipment manufacturer. They will also need to be able to identify and explain how to rectify faults in the systems.

In addition learners will need to be able to carry out the required out of season lay up procedures for different systems. This will include cleaning and servicing, ensuring that the systems are stored in such a way as to prevent deterioration, corrosion and damage by weather and other external forces, e.g. vermin.

For Outcome 4 learners will need to be able to explain the operation control procedures for different types of cutting and lifting mechanisms. This will include settings as set out by the manufacturer, adjustments made in the field to accommodate crop, soil and weather conditions. Learners will also need to be able to explain the use of manufacturers' specification and data used to achieve the required results for crop cutting and lifting mechanisms. This will require the use of operators manuals and other manufacturers information, the requirements of the customer and any other requirements there may be for further processes after the crop has been harvested.

The use of the machines as identified in Outcome 1 for all the Outcomes should be seen as acceptable and good practice.

References

Books

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www.howstuffworks.com	How Stuff Works
www.iagre.org	Institution of Agricultural Engineers

Unit 343 Understanding and Servicing Mechanical Power Transmission Systems

Level: 3

Credit value: 10

Unit aim

This unit aims to introduce learners to mechanisms and methods of transmitting mechanical power in land based vehicle and machine drivelines and how knowledge of this can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

The aim of this unit is for learners to familiarise themselves with mechanisms and methods of transmitting mechanical power in land based vehicle and machine drivelines.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will be able to:
1. Know the types of components used to transmit mechanical drives
2. Understand drive system limitations and use
3. Service and maintain mechanical drive systems
4. Overhaul and repair mechanical drive systems that have failed

Guided learning hours
It is recommended that **60** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards
This unit is linked to the National Occupational Standards for Land-based service engineering.

Endorsement of the unit by a sector or other appropriate body
This unit is endorsed by Lantra SSC.

Assessment and grading
This unit will be assessed by:
- An assignment covering practical skills and underpinning knowledge.

Unit 343 Understanding and Servicing Mechanical Power Transmission Systems

Outcome 1 Know the types of components used to transmit mechanical drives

Assessment Criteria
The learner can:
1. Describe the **function** of a given range of **mechanical transmission components**
2. Identify any **faults or wear areas** on a range of mechanical transmission components
3. Select from the range of components, items that would make up a **complete mechanical drive system** and describe how the system operates
4. From a selected range of mechanical transmission systems, state the possible **factors** resulting in the manufacturer's choosing that system.

Unit content

Function
How it transmits power

Mechanical transmission components
Shafts, Universal Joint, constant velocity joint, gears, belts, chains, springs, overrun device, slip clutch, shear bolts, keys and keyways. Compression/tension springs, bearings, bushes and friction drive components.

Faults or wear areas
Misalignment, bearing failure, stretched components from heat/overload, worn components from lack of lubrication, worn components from excessive friction. Broken components from overload/shock loadings. Breakages/wear due to lack of maintenance

Complete mechanical drive system
Gearbox, transfer box, belt and pulley systems, chain and gear systems, shaft and UJ/CV joints

Factors
Cost, power and torque transmitted, driveline protection required, operating conditions, components available to manufacturer, components used in same or other machines in manufactures range.

Unit 343 Understanding and Servicing Mechanical Power Transmission Systems

Outcome 2 Understand drive system limitations and use

Assessment Criteria
The learner can:
1. Explain the **limitations** of different **types of mechanical drive systems**
2. Compare **reasons** as to where different systems are suited and unsuitable

Unit content

Limitations
Power, torque and speed, capacity. longevity, serviceability, size of transmission unit

Types of mechanical drive systems
Shafts, Universal Joint, constant velocity joint, gears, belts, chains, springs, overrun device, slip clutch, shear bolts, keys and keyways. Compression/tension springs, bearings, bushes and friction drive components

Reasons
Power, torque and speed, capacity. longevity, serviceability, size of transmission unit, cost of unit, cost of servicing/repair, Input source, operating conditions

Unit 343 Understanding and Servicing Mechanical Power Transmission Systems

Outcome 3 Service and maintain mechanical drive systems

Assessment Criteria
The learner can:
6. Carry out an **assessment** of possible **risks** prior to performing service and maintenance tasks to the **mechanical drive systems** on **land-based vehicles and machines**
7. Following manufacturers guidelines, carry out **periodic maintenance and adjustments** on mechanical transmission systems
8. Produce **service tasks** to suit the transmissions maintained detailing all **critical adjustments and measurement data**
9. **Report** on possible implications due to incorrect maintenance and adjustments to each system.

Unit content

Assessment
Visual, audible, written risk assessment

Risks
Slips, trips, falls, heavy loads, falling objects, oils and fluids, heat, high pressure fluids

Mechanical drive systems
Gearbox, transfer box, belt and pulley systems, chain and gear systems, shaft and UJ/CV joints

Land-based vehicles and machines
Hand held, pedestrian, self propelled, mounted, trailed machines

Service tasks
Written procedures covering routine maintenance, strip down and/or rebuild

Critical adjustments and measurement data
Backlash, alignment, clearance, spacing/shimming, bearing preload, tightening torque, locking of fasteners, gear contact pattern, spacing, tension/compression spring length

Report
Verbal, written or visual

Unit 343 Understanding and Servicing Mechanical Power Transmission Systems

Outcome 4 Overhaul and repair mechanical drive systems that have failed

Assessment Criteria
The learner can:

6. Produce a **plan of work** to outline the procedure to be adopted for the removal of a **mechanical transmission unit** from a **land-based vehicle** or machine in preparation for **overhaul or repair**
7. Produce a **risk assessment** prior to performing practical removal, overhaul or repair procedures to a transmission unit
8. Carry out a removal, overhaul and repair task on a mechanical land-based transmission unit and check the **integrity of the unit** on completion
9. **Report** on the overhaul and repair process, specialised tools, equipment and materials used

Unit content

Plan of work
Order of dismantling and refitting of unit. Draining, storage, disposal and refilling of fluids
Risk assessment
Tools required, Personal Protective Equipment (PPE)

Mechanical transmission unit
Gearbox, transfer box, belt and pulley systems, chain and gear systems, shaft and UJ/CV joints

Land-based vehicle
Hand held, pedestrian, self propelled, mounted, trailed machines

Overhaul or repair
Daily, weekly monthly and annual service, wearing part replacement, breakdown repair

Risk assessment
Careful examination of what could cause harm to people, so that it can be weighed up whether enough precautions have been taken or should more be done to prevent harm. Record in a manner so others can see the risks involved easily

Integrity of the unit
Fitness of unit for the purpose it was designed for

Report
Concise report, easy to see, such as a comparison table

Unit 343 Understanding and Servicing Mechanical Power Transmission Systems

Notes for guidance

This unit covers the basic transmission components and how they are connected to make up mechanical drive systems. Covers the servicing and repair, removal, replacement and setting up of these components. It also allows the learner to understand why manufacturers choose certain components to make up complete transmission systems.

Centres and tutors need to be aware of the need to safeguard learners, when delivering and assessing units where the operation and servicing of machinery is involved. This unit requires the learner to undertake machinery servicing under close supervision. Throughout delivery of the unit the emphasis should be on acceptable health and safety procedures and safe working practices. The guidance in this unit requires that Health and Safety must be strictly enforced and repeated throughout.

Outcome 1 looks at the function of the components, where they are liable to wear, or break. The second part looks at how components are combined to make transmission units, and why choose certain units to land based machinery. This unit will require classroom based delivery however the learner will benefit from practically based activities in order to develop knowledge of a range of components and machinery.

Outcome 2 will require the learner to understand the limitations of different components, and why different components are suited for different tasks. Outcome 1 and Outcome 2 could be taught in conjunction with each other as Outcome 2 can develop the knowledge learnt in Outcome 1. Delivery of this Outcome will largely involve classroom based delivery however the learner should have access to a range of components to help develop knowledge and understanding.

Outcome 3 requires the learner to assess service, adjust and produce service tasks on power transmission systems. The learner will also be expected to understand the possible problems that may be caused by incorrect maintenance and adjustments. Outcome 3 will involve a mixture of classroom based and practically based delivery.

Outcome 4 allows the learner to expand on Outcome 3, by planning and carrying out removal overhaul and repair of components, including producing a risk assessment. The learner will also be required to produce a report on the task that they have completed. This Outcome requires the learner to assess the full process of land based machinery mechanics by producing assessments and reports as well as carrying out practical based work. This Outcome is mainly practically based, but some classroom activity will be required for the learner to produce assessments and reports.

References

Books

Bell B. 2005. *Farm Machinery*. Old Pond Publishing. ISBN 1903366682
Culpin C. 1992. *Farm Machinery,12th edition*. Blackwell Scientific. ISBN 063203159X
Hillier V and Coombes P — *Hillier's Fundamentals of Motor Vehicle Technology, 5th Edition* (Nelson Thornes, 2004) ISBN 0748780823
Whipp J and Brooks R — *Transmission, Chassis and Related Systems (Vehicle Maintenance and Repair Series: Level 3), 3rd Edition* (Thomson Learning, 2001)ISBN 186152806X
Manufacturers publications and manuals

Journals

Farmers Guardian
Profi International
Farmers Weekly

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.defra.gov.uk	Dept for Environment, Food and Rural Affairs
www.wales.gov.uk	Welsh Assembly Government
www.scotland.gov.uk	Scottish Executive Environment and Rural Affairs Department
www.dardni.gov.uk	Department of Agriculture and Rural Affairs (Northern Ireland)
www.hse.gov.uk	Health and Safety Executive
www.howstuffworks.com	How Stuff Works
www.iagre.org	Institution of Agricultural Engineers

City & Guilds

Skills for a brighter future

www.cityandguilds.com

Appendix 1 Relationships to other qualifications

Literacy, language, numeracy and ICT skills development

These qualifications include opportunities to develop and practise many of the skills and techniques required for success in the following qualifications:

- Functional Skills (England) – see **www.cityandguilds.com/functionalskills**
- Essential Skills (Northern Ireland) – see **www.cityandguilds.com/essentialskillsni**
- Essential Skills Wales – see **www.cityandguilds.com/esw**

There might also be opportunities to develop skills and/or portfolio evidence if learners are completing any Key Skills alongside these qualifications.

Appendix 2 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on **www.cityandguilds.com**.

Providing City & Guilds qualifications – a guide to centre and qualification approval contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of learners
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

Ensuring quality contains updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document contains information on:

- Management systems
- Maintaining records
- Assessment
- Internal verification and quality assurance
- External verification.

Access to Assessment & Qualifications provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for learners who are eligible for adjustments in assessment.

The **centre homepage** section of the City & Guilds website also contains useful information such as:

- ***Walled Garden***
  Find out how to register and certificate learners on line
- ***Events***
  Contains dates and information on the latest Centre events

Useful contacts

Type	Contact	Query
UK learners	T: +44 (0)84 4543 0033 E: learnersupport@cityandguilds.com	• General qualification information
Centres	T: +44 (0)84 4543 0000 F: +44 (0)20 7294 2413 E: centresupport@cityandguilds.com	• Exam entries • Registrations/enrolment • Certificates • Invoices • Missing or late exam materials • Nominal roll reports • Results
Walled Garden	T: +44 (0)84 4543 0000 F: +44 (0)20 7294 2405 E: walledgarden@cityandguilds.com	• Re-issue of password or username • Technical problems • Entries • Results • GOLA • Navigation • User/menu option problems
Employer	T: +44 (0)121 503 8993 E: business_unit@cityandguilds.com	• Employer solutions • Mapping • Accreditation • Development Skills • Consultancy

If you have a complaint, or any suggestions for improvement about any of the services that City & Guilds provides, email: **feedbackandcomplaints@cityandguilds.com**

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