



Higher National Unit Specification

General information

Unit title: Forest Science (SCQF level 8)

Unit code: HX5M 35

Superclass: RK

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Version: 01

Unit purpose

This unit is designed to give the learner knowledge of the environmental and plant physiological factors and processes that affect tree growth.

The unit is relevant to learners requiring underpinning knowledge of tree growth and is suited to those working, or wishing to work, in the forestry or arboricultural sectors.

Outcomes

On successful completion of the unit the learner will be able to:

- 1 Analyse factors that affect tree growth.
- 2 Produce a collection of woody plants.
- 3 Explain plant physiology, tree growth and development.
- 4 Explain temperate woodland ecosystems in the United Kingdom.

Credit points and level

2 Higher National Unit credit(s) at SCQF level 8: (16 SCQF credit points at SCQF level 8)

Recommended entry to the unit

Entry to this unit is at the discretion of the centre. It would be beneficial if learners had some previous knowledge of earth or biological science, for example relevant National 5 qualification or equivalent.

Higher National Unit Specification: General information (cont)

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Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the support notes for this unit specification.

There is no automatic certification of Core Skills or Core Skill components in this unit.

Context for delivery

If this unit is delivered as part of a group award, it is recommended that it should be taught and assessed within the subject area of the group award to which it contributes.

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

Higher National Unit Specification: Statement of standards

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Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Analyse factors that affect tree growth.

Knowledge and/or skills

- ◆ Geographic factors
- ◆ Weather and climatic factors
- ◆ Geological factors
- ◆ Soil information

Outcome 2

Produce a collection of woody plants.

Knowledge and/or skills

- ◆ Plant classification systems
- ◆ Morphological characteristics of plants
- ◆ Botanical keys

Outcome 3

Explain plant physiology, tree growth and development.

Knowledge and/or skills

- ◆ Photosynthesis and respiration
- ◆ Mineral nutrients
- ◆ Uptake and transport of water, mineral nutrients and metabolites
- ◆ Plant growth substances
- ◆ Vegetative cell division
- ◆ Shoot and root systems
- ◆ Structure of flowers

Higher National Unit Specification: Statement of standards (cont)

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Outcome 4

Explain temperate woodland ecosystems in the United Kingdom.

Knowledge and/or skills

- ◆ Climax communities and the process of succession
- ◆ Abiotic and biotic factors
- ◆ Distribution of ecosystems
- ◆ Biodiversity, habitats, communities and food webs
- ◆ Decomposition process

Evidence requirements for this unit

Learners will need to provide evidence to demonstrate their knowledge and/or skills across all outcomes by showing that they can:

Outcome 1

- ◆ Analyse geographic information and use this to recommend forestry practices appropriate to a given site, including consideration of location, latitude, altitude, aspect, terrain and slope
- ◆ Interpret weather and climatic information and use this to recommend forestry practices appropriate to a given site, including consideration of precipitation, temperature and wind exposure
- ◆ Interpret geological information and use this to recommend forestry practices appropriate to a given site, including consideration of the characteristics of solid and drift geology
- ◆ Analyse the soil information from a soil survey on site and relevant maps and produce a soil map. The soil survey must include:
 - Analysis of vegetation cover
 - Soil profile diagrams
 - Soil horizon identifications and descriptions
 - Identification of soil types and soil influence on tree species and operation choice
- ◆ Use the Ecological Site Classification (ESC) to assess tree species and native woodland type suitability on the basis of ESC climatic variables and on-site soil and vegetation assessment
- ◆ Describe the predicted changes in future climate and the potential impact of these changes on tree species and native woodland type suitability

Outcome 2

- ◆ Produce a collection of 60 woody plant species or cultivars, accurately labelled according to the binomial system. The collection should demonstrate the learner's understanding of morphological characteristics, genus and species of plants

Higher National Unit Specification: Statement of standards (cont)

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Outcome 3

- ◆ Explain C3 photosynthesis and respiration and the factors affecting the performance of these processes
- ◆ Identify the mineral nutrients essential for plant growth and metabolism and explain the role(s) each perform
- ◆ Explain the processes, tissues and organs involved in the uptake and transport of water, mineral nutrients and metabolites
- ◆ Identify the main plant growth substances and explain the role(s) each fulfils
- ◆ Explain vegetative cell division (mitosis) as it relates to the activity of apical and lateral meristems
- ◆ Explain how the shoot and root systems of a woody plant develop from meristematic activity and cell differentiation
- ◆ Describe the structure of flowers and explain the processes leading to the development of seeds and concept of seed years

Outcome 4

- ◆ Describe the common woodland ecosystems found in the United Kingdom
- ◆ Explain the abiotic and biotic factors involved in the development of UK woodland systems
- ◆ Explain the term 'biodiversity' and the role of individual species within woodland communities, including reference to habitats, communities and food webs
- ◆ Explain the process of succession and identify the key species of two climax communities
- ◆ Explain the importance of the decomposition process and organisms involved to woodland ecosystems and communities they support, including consideration of decomposers and nutrient cycling



Higher National Unit Support Notes

Unit title: Forest Science (SCQF level 8)

Unit support notes are offered as guidance and are not mandatory.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 80 hours.

Guidance on the content and context for this unit

This unit has been designed as a mandatory component of the HNC/D in Forestry and the HNC/D in Arboriculture and Urban Forestry.

The unit is intended to provide the learner with an understanding of the basics of the underpinning scientific principles in relation to the factors that influence tree growth in the UK.

The following sections relate to the corresponding outcomes:

Outcome 1

- ◆ Geographic and topographic factors:
 - Latitude, longitude, altitude, aspect, slope, terrain
- ◆ Climate and weather:
 - Earth's atmosphere and circulatory system
 - Characteristics of weather systems, high and low pressure air masses, frontal systems
 - Continental and maritime climates, seasonal effects
 - Prevailing wind, exposure, rainfall, snow, frost, drought, evapo-transpiration
 - ESC climate variables (accumulated temperature, moisture deficit, continentality, Detailed Aspect Methods of Scoring (DAMS score))
 - Influence of weather on tree growth: exposure, drought, waterlogging, establishment, disease, fire
 - Influence of weather on woodland/forest operations: rain, wind, frost, snow
- ◆ Geology:
 - Origins of sedimentary, igneous and metamorphic rocks
 - Identification of sedimentary, igneous and metamorphic rocks, basic identification of sandstone, limestone, conglomerate, schist, gneiss, granite, basalt, slate, shale, marble, flint, fossils
 - Elements, compounds, crystals, minerals (eg, mica, quartz, feldspar)
 - Drift geology, peat, glacial and river deposits, wind deposits
- ◆ Soils:
 - Processes of soil formation: physical, chemical, biological and their interaction, the time factor, glaciation
 - Forest soil classification and its importance: dig soil pits, horizon and profile description and interpretation and record findings
 - Soil structure, texture and properties: tests for texture, structure and pH, identify rootability and stoniness and significance of soil colour and smell
 - Identification of soil types by means of their horizons and soil profiles
 - Soil type and its influence on woodland operations: texture, structure, wetness, dryness, nutrient status
 - Soil type and its influence on choice of plant species

Higher National Unit Support Notes (cont)

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- ◆ Using Ecological Site Classification:
 - Use of indicator species to assess soil nutrient and soil moisture regimes
 - Guidance for tree species and native woodland type suitability assessment

Outcome 2

- ◆ Classification of living organisms: Animalia, Plantae, Fungi, Monera, Protoctista
- ◆ Linnaeus, binomial system: genus, species, cultivars; meaning of scientific names
- ◆ Leaves, flowers and buds, their arrangement on stems, bark
- ◆ Requirements for nutrients, moisture, pH, light

Outcome 3

- ◆ C3 photosynthesis (water + carbon dioxide in presence of light energy = sugar), effect of light intensity and quality, temperature, carbon dioxide concentration
- ◆ Respiration, gross and net, aerobic and anaerobic
- ◆ Plant nutrients: macronutrients, micronutrients, trace elements: their role in plant metabolism; deficiencies, visual symptoms
- ◆ Transpiration, stomata, water and mineral nutrient uptake, translocation of metabolites
- ◆ Plant growth substances: abscisic acid, auxin, cytokinins, ethylene and gibberellins: their role in plant growth and development
- ◆ Idealised meristematic cell, the process of mitosis, cell division in three planes
- ◆ Structure of shoot and root apices, structure of cambial layer
- ◆ Structure of leaves and buds, phyllotaxy, shoot and root elongation
- ◆ Development of secondary xylem and phloem
- ◆ Structure of flowers; sepals, petals, stamens, stigma, ovary, ovules
- ◆ Pollination process and agencies, fertilisation process, development of fruits and seeds, mast years
- ◆ Seed dispersal, seed dormancy, germination process, effect of temperature, moisture and light
- ◆ Structure of DNA; double helix, base sequences
- ◆ Stages of meiosis; haploid, diploid
- ◆ Definition of gene, chromosome, Mendelian inheritance
- ◆ Genotypic and phenotypic variation; genetic variation within natural range, ecotypes; seed origin and provenance, their significance in forestry practice
- ◆ Tree breeding including progeny testing; hybrid larch; seed orchards

Outcome 4

- ◆ Process of succession, pioneer and climax woodland plant communities
- ◆ Woodland types, biotic and abiotic influences, grasslands, moorland
- ◆ Concept of habitat, species diversity, food webs
- ◆ The decomposers, nutrient cycling (N, P, K)

Please note that the examples given are for guidance and should not be considered as an exhaustive list.

Higher National Unit Support Notes (cont)

Unit title: Forest Science (SCQF level 8)

Guidance on approaches to delivery of this unit

In this unit learners will acquire a range of basic scientific knowledge and site evaluation skills which are applicable across many elements of forestry and arboricultural practice. The concepts introduced in this unit will underpin future studies. The unit should ideally be delivered through a mixture of lectures, site visits and practical exercises in a relevant field-based setting, with supporting online teaching materials provided to learners.

Although some parts of Outcome 1 are suited to classroom-based learning (theoretical elements of geology, soil science and climate), a significant amount of time should be spent in field-based environments. During this time learners should have the opportunity to develop and practise the skills required to describe and classify soils, assess topography and identify ground flora as indicators of soil nutrient and moisture status. Ideally learners should be introduced to a range of site types. Learners will generally work in groups to collect the site data required for the Outcome 1 assessment and, depending on the size of the assessment site, data from groups within a class may be pooled to give learners the information they require to assess the site as a whole. Project reports will be prepared by learners individually.

Learners may have been given the Outcome 2 assessment with their course joining instructions and some may therefore have completed or at least started compiling their tree species collection before formal teaching begins. The delivery of Outcome 2 will generally take the form of lectures and supporting materials covering classification of living organisms, plant nomenclature conventions and the use of botanical keys to identify species by their plant morphological characteristics. Where possible lectures should be complemented by accompanying demonstrations and field visits focusing on the development of learners' tree identification skills.

In Outcome 3 learners are given a broad introduction to the physiological processes underlying plant physiology, tree growth and development. The majority of the topics can be delivered as well-illustrated lectures, with suitable supporting materials (eg, videos available online) and suggested additional reading provided to learners. Some elements could be supported by practical laboratory demonstrations where facilities are available eg, examining wood structure in samples using hand lenses.

Delivery of Outcome 4 is likely to be through a mixture of lectures, supporting notes, online materials and practical field exercises to introduce learners to different types of plant communities and woodland types.

Quizzes and/or online revision questions can be used to help students prepare for Outcome 3 and 4 assessments.

Delivery of this unit could be integrated with unit *Establishment of Woodland* (F3YC 34), with both units being run concurrently and the assessment site used for Outcome 1 of *Forest Science* also used for the project report in *Establishment of Woodland*.

Open learning

This unit could be delivered via distance learning, provided learners are able to participate in the field-based practical work required. This could be through specific study days organised for distance learners at the delivery centre. Alternatively, learners could undertake the required field work independently using sites agreed with the unit tutor, and providing suitable evidence (eg, photos). The latter option is likely to be most appropriate for (but need not be restricted to) learners already working in the forestry, arboriculture or related sectors.

Higher National Unit Support Notes (cont)

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Guidance on approaches to assessment of this unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Outcome 1

The evidence of achievement for Outcome 1 could take the form of a project report on a given or an agreed site, supported by appropriate maps, tables and diagrams, that detail the climatic, geological and soil conditions on that site and their influences in relation to tree growth (suggested word limit of 1,200 words or equivalent).

The report could be set on a site that could be planted with new forest/woodland cover, a restocking site or established woodland that needs to be redesigned for a specified purpose that would require some replanting.

It is suggested that the site be tailored to meet the needs of the learners by the design of the assessment reflecting the aims of the award they are studying and prevailing industry needs (ie, forestry or arboriculture or community/urban forestry).

It is suggested that this assessment should be made available to the learner midway through the unit delivery so that data collection and analysis can start in good time.

Likely scenarios for this report could be:

- (a) A report on a given site that displays enough diversity of terrain and vegetation type that would require the learner, individually or as part of a small team, to utilise maps and site visits to visually survey the area and establish the geology, topographical features, altitude, location and aspect of the area.

It is suggested that the site should require the digging and interpretation of the soil profiles of at least three soil pits that would determine expected different soil types, and therefore the presumption of differing forest operations and species choice.

The exercise would also require the use and interpretation of climatic data and site factors to determine site micro-climates.

The report should be supported with a location map, a soil map and, if appropriate, a tree species map.

- (b) As above, but in the case of a distance/open learning learner, for a site of the learner's choice ie, at their work or close to their home, with the caveat that the site has to be agreed as suitable beforehand by the unit tutor and that there is prior agreement for learner and possible tutor access to the site by the landowner.

Higher National Unit Support Notes (cont)

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Outcome 2

The evidence for Outcome 2 will take the form of a personal collection of woody plant species or cultivars, accurately labelled according to the binomial system. It is suggested that the project could be split between about 40% conifer and 60% broadleaved species/cultivars, and that learners should be given a minimum number of samples to collect, to be decided by the centre.

The learner should be encouraged to collect leaf samples and also twig, flower/cone and fruit samples where appropriate. The leaf samples should be pressed and mounted and giving their Latin and common names and the location they were found.

Learners should be advised to seek permission for sample collection.

It is suggested that this project is given to the learner along with the course joining instructions, where possible, and submitted within the first six weeks of starting the unit. This will give the learner the opportunity for self-study and allow them to collect and prepare specimens at the most appropriate time of year.

Outcomes 3 and 4

It is recommended that Outcomes 3 and 4 be assessed holistically. This could take the form of restricted response questions covering the knowledge and skills for each outcome. Elements within each knowledge and skill item could be sampled with a different element being sampled on each occasion. If sampling is carried out this must be done on a closed-book basis.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the evidence requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing Core and other essential skills

There is no automatic certification of Core Skills or Core Skills components in this unit, however there may be opportunities to develop the Written Component of the Core Skill of *Communication* at SCQF level 5, through the research and reporting activities.

History of changes to unit

Version	Description of change	Date

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General information for learners

Unit title: Forest Science (SCQF level 8)

This section will help you decide whether this is the unit for you by explaining what the unit is about, what you should know or be able to do before you start, what you will need to do during the unit and opportunities for further learning and employment.

This unit is designed to provide you with a basic knowledge of the underlying scientific principles for the establishment, maintenance and growth of woodland/forest trees.

The unit will provide you with the required skills and knowledge to assess a site for its woodland potential and will involve practical site work to help achieve this.

In order to achieve this unit you will undertake the following outcomes:

Outcome 1 will give you a basic knowledge of geology and soils in relation to their influence on tree growth and the woodland/forest environment and the skills needed to identify rock groupings and soil types in the field. The unit will also enable you to understand the principles of climate and weather and how it influences tree growth and the woodland/forest environment.

Outcome 2 examines the naming and categorising of plants and animals, leading to the identification of common woody plants and an appreciation of the uses and cultural needs. You will be asked to compile a leaf collection as the assessment for this outcome and you may be required to do this prior to attending the centre.

Outcome 3 will give you a basic understanding of tree physiology and the factors which influence and control tree growth in relation to environmental factors. It will also provide you with a basic understanding of the growth of the component parts of woody plants from germination to a mature plant, producing seed. In addition, the unit will provide you with a basic understanding of genetic variation in trees and its relation to choice of planting stock.

Outcome 4 will provide you with a basic understanding of the dynamic processes contributing to woodland ecology and the biodiversity of woodland communities.

Overall, the knowledge and skills acquired in this unit will help you understand the influencing factors of tree growth, tree physiology and develop your tree and plant recognition and identification skills.

You will be assessed in this unit through establishing a collection of woody plants, and producing a report on tree growth and answering questions on botany.