Higher National Unit specification

General information for centres

Unit title: Genetics for Plant Science

Unit code: F1MK 35

Unit purpose: This Unit aims to introduce the candidate to basic understanding of plant genetics. Candidates will gain an understanding of genes and variation, the mechanism of inheritance, plant breeding systems and selection in populations. The knowledge gained from this Unit will underpin future study of plant and crop improvement through breeding the development and exploitation of new plant and crop products.

On completion of the Unit the candidate should be able to:

1 Explain the concept of the gene and genetic variation.
2 Explain inheritance in terms of Mendelian genetics.
3 Describe the basis and consequences of different breeding systems in plants.
4 Describe the mechanisms of genetic change in populations.

Credit points and level: 1 HN credit at SCQF level 8: (8 SCQF credit points at SCQF level 8*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Recommended prior knowledge and skills: Prior knowledge or skills are not essential for this Unit. However, it would be beneficial for candidates to have had Standard or Higher Grades in Biology and/or Chemistry subjects.

Core Skills: There are opportunities to develop Core Skills of *Numeracy* and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

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.

Assessment: The assessment of this Unit can reflect the teaching approach taken by a particular centre. Outcome 1 and 2 could be assessed together, in a form of a restricted response test (closed-book), alternatively one or both could be based on a report of practical exercises undertaken in a laboratory or glasshouse context. Outcome 3 can be a written report or case study. Outcome 4 would normally be assessed in the form of an extended response test (closed-book). The assessment of Outcomes 3 and 4 could be combined in the form of a restricted response test (closed-book) if the method of teaching of these Outcomes was appropriate to this assessment format.

Higher National Unit specification: statement of standards

Unit title: Genetics for Plant Science

Unit code: F1MK 35

The sections of the Unit stating the Outcomes, Knowledge and/or Skills, and Evidence Requirements are mandatory.

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. Candidates 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

Explain the concept of the gene and genetic variation

Knowledge and/or Skills

- Theoretical concept of gene and structure of DNA
- Basis of gene expression
- Mutation and generation of genetic variation

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- explain the information coding capability of DNA, based on the knowledge of the double helix and complementary base pairing.
- explore the concept of gene expression and the genetic code
- describe the effect of mutation

Assessment Guidelines

This Outcome could be assessed as a restricted response test (closed-book) to ensure that the candidates have basic scientific knowledge required for this subject. Alternatively, the Outcome could be assessed as a report of a laboratory or glasshouse exercise investigating an aspect of genetic variation, gene expression or mutation.

Higher National Unit specification: statement of standards (cont)

Unit title: Genetics for Plant Science

Outcome 2

Explain inheritance in terms of Mendelian genetics

Knowledge and/or Skills

- Principle of segregation
- Principle of independent assortment
- Gene interactions

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- interpret patterns of allele segregation in terms of Mendelian laws
- explain the consequences of gene interaction on Mendelian expectations

Assessment Guidelines

This Outcome could be assessed in as a class test (closed-book) or following a practical exercise on genetic segregation.

Outcome 3

Describe the basis and consequences of different breeding systems in plants

Knowledge and/or Skills

- Outbreeding and inbreeding
- Clonal populations
- Hybridization
- Transgenics

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- discuss the difference between outbreeding, inbreeding and clonal systems on plant population structure
- describe the relevance of breeding system to plant breeding methods
- discuss the techniques available for plant genetic improvement

Assessment Guidelines

This Outcome could be assessed as case study of a named plant or group of plants presented as examples of the concepts and processes involved. Alternatively it could be covered as a class test, if necessary in conjunction with Outcome 4.

Outcome 4

Describe the mechanisms of genetic change in populations

Knowledge and/or Skills

- Selection, including natural selection
- Hardy-Weinberg equilibrium
- Species and speciation

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- calculate genotype frequencies from allele frequencies
- explain the effect of selection on populations

Assessment Guidelines

This Outcome will be assessed in the form of extended answer (closed-book) assessment.

Administrative Information

Unit code: F1MK 35

Unit title: Genetics for Plant Science

Superclass category: RH

Original date of publication: July 2008

Version: 01

History of changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Genetics for Plant Science

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit aims to develop candidate understanding of basic principles of genetics for plant science and horticulture students. Candidates are not expected to have studied genetics prior to attempting this module, however, some basic biological knowledge, such as the structure of cells and concepts of cell division are assumed.

Outcome 1 introduces candidates to the concept of the gene as a unit of inheritance. Students will learn how the structure of DNA allows faithful replication of the DNA molecule and the encoding of information. Gene expression will be explained and variation through mutation explored both in terms of the biochemical changes that can occur and the importance of this process in the generation of genetic variability. Where time and facilities allow this Outcome can be taught with reference to living material and/or laboratory experimentation.

In Outcome 2 candidates will introduce the laws of inheritance identified by Mendel. Students will understand the principle of segregation and independent assortment. Interpretation of segregation ratios in terms of gene interactions and linkage will also be covered. Again, where time and facilities allow this Outcome can be taught with reference to living material and/or laboratory or glasshouse experimentation

Outcome 3 will give candidates a clear understanding of the different breeding populations seen in plants and the consequence for plant breeding, development of new cultivars and the effect of breeding system on the strategies available for plant improvement though breeding. The use of alternative techniques for plant genetic improvement would be covered, including the use of hybrids and transgenic technologies.

In Outcome 4 candidates will extend the candidates understanding of inheritance and genetic change to explore the concept of populations and the gene pool. Candidates will be expected to be able to explain the concept of ideal populations with reference to real populations. Candidates should be able to calculate allele and genotype frequencies using the Hardy-Weinberg equations and to relate changes in these frequencies to concepts of selection and speciation.

Guidance on the delivery and assessment of this Unit

It is recommended that this Unit be taught through a series of lectures, which could be supplemented by practical classes. Practical classes could include laboratory of glasshouse investigations and may involve organisms other than plants (eg Fungi) for ease of manipulation and to overcome time restraints.

Suitable approaches to generating evidence may include supplementing a student-centred written assignment with an oral explanation by the candidate.

Higher National Unit specification: support notes (cont)

Unit title: Genetics for Plant Science

For the teaching of the Outcomes 1 and 2 the following references are recommended:

Campbell, N. A. & Reece, J. B. (2002), 'Biology', 6th Edition. San Fransisco: Benjamin Cummings. 1247 pp.

Leventin, & McMahon, (2003), 'Plants & Society', 3rd Edition. New York: McGraw Hill. 508 pp.

For the teaching of Outcome 3 the following reference is recommended:

Smartt, J. & Simmonds, N. W. (1995), 'Evolution of Crop Plants.' Harlow, Essex: Longman Scientific & Technical. 531 pp.

For the teaching of Outcome 4 the following reference is recommended:

Campbell, N. A. & Reece, J. B. (2002), 'Biology', 6th Edition. San Fransisco: Benjamin Cummings. 1247 pp.

Opportunities for developing Core Skills

There will be opportunities to develop Core Skills in this Unit, particularly in numeracy and logical analysis, although there is no automatic certification of Core Skills or Core Skills components.

Open learning

Elements of this Unit could be delivered by distance or flexible learning. However, if Outcomes are to be assessed on the basis of practical exercises, attendance at these sessions would be required.

Candidates with disabilities and/or additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* **(www.sqa.org.uk)**.

General information for candidates

Unit title: Genetics for Horticulture and Plant Science

This Unit aims to develop candidate skills

Outcome 1 introduces concepts of genes and inherited characters. You will be able to explain the genetic code and to predict the consequences of particular changes to a DNA sequence on the structure and composition of the encoded protein product.

In Outcome 2 you will explore the laws of inheritance and gain an understanding into the ways particular genetic characters are passed from one generation to the next. Allied to these skills you will be able to practice logical thinking and problem solving through these tasks.

In Outcome 3 you will gain an insight into the diversity of plants breeding systems and the consequences for cultivar development and maintenance. The assessment of this Outcome will allow you to focus on a plant or crop species of particular interest.

In Outcome 4 you will gain an understanding of evolutionary processes as they relate to populations, selection and speciation. This knowledge will assist in discussions of biodiversity and the management of natural plant communities, and the maintenance of biodiversity generally.