## Higher National Unit specification

## General information for centres

**Unit title:** Plant Physiology

**Unit code:** F1MS 34

**Unit purpose:** The aim of this Unit is to provide students with knowledge and understanding of the physiological processes involved in plant growth. It provides the foundation for more advanced Units examining crop physiology at the canopy level, the molecular and biochemical basis of plant growth and plant-environment interactions. Understanding the processes underlying plant growth is an important foundation for a career in crop production, plant science, biotechnology or horticulture. On completion of the Unit the candidate should be able to:

1 Explain the mechanism of photosynthesis.
2 Explain the transport and partitioning of assimilates in plants.
3 Explain the flow of water through plants and tissues.
4 Explain the absorption and translocation of nutrient ions by plants.

**Credit points and level:** 1 HN credit(s) at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**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:** Access to this Unit is at the discretion of the delivering centre, however, it would be beneficial for candidates to have studied biology or other relevant science subject preferably Standard Grade SCQF level 5 or equivalent. National Units that are relevant to this Unit include Plant Structure and Function (intermediate 2), Plant Physiological Processes (Higher), and Environmental Physiology of Plants (Higher).

**Core Skills:** There are opportunities to develop the Core Skill(s) of Numeracy at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

## Higher National Unit specification

## General information for centres (cont)

**Assessment:** Assessment can reflect the teaching/learning approach taken by a particular centre.
Assessment would normally be closed-book and held under supervision.
Assessment would normally be based on extended response, short answer or restricted response questions sampling the content listed in the knowledge and/or skills section.
Each Outcome may be assessed separately or combined with others reflecting the teaching/learning approach.

# Higher National Unit specification: statement of standards

## Unit title: Plant Physiology

## Unit code: F1MS 34

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 mechanism of photosynthesis

### Knowledge and/or skills

- The exchange of carbon dioxide between leaves and the atmosphere
- The light reactions of photosynthesis,
- The biochemical pathways of photosynthesis and photorespiration in terms of major intermediates and the enzyme ribulose bisphosphate carboxylase/oxygenase
- The major differences in photosynthesis between C3, C4 and CAM plants

### Evidence Requirements

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

- explain the exchange of carbon dioxide between leaves and the atmosphere in higher plants
- explain the light reactions of photosynthesis in higher plants
- explain the biochemical pathways of photosynthesis and photorespiration in terms of major intermediates and the enzyme ribulose bisphophate carboxylase/oxygenase
- explain the major differences in photosynthesis between C3, C4 and CAM plants

### Assessment guidelines

This Outcome could be assessed by extended response, restricted response or short answer questions under closed-book supervised conditions that enable the candidate to explain the component processes of photosynthesis. The assessment for this Outcome may be combined with one or more other Outcomes.

## Higher National Unit specification: statement of standards (cont)

## Unit title: Plant Physiology

## Outcome 2

### Explain the transport and partitioning of assimilates in plants

### Knowledge and/or skills

- Assimilate movement within plants.
- Assimilate partitioning in plants in terms of sources, sinks, and relative sink strength.

### Evidence Requirements

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

- describe assimilate movement within plants
- explain assimilate partitioning in plants in terms of sources, sinks, and relative sink strength

### Assessment guidelines

This Outcome could be assessed by extended response, restricted response or short answer questions under closed-book supervised conditions that enable the candidate to explain the transport and partitioning of assimilates in higher plants. The assessment for this Outcome may be combined with one or more other Outcomes.

## Outcome 3

Explain the flow of water through plants and tissues

### Knowledge and/or skills

- Water relations of cells of higher plants in terms of water potential, solute potential and turgor potential
- Transpiration in higher plants
- Root water uptake in higher plants
- Water flow across plant tissues and through xylem vessels

## Higher National Unit specification: statement of standards (cont)

## Unit title: Plant Physiology

### Evidence Requirements

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

- explain water relations of cells in higher plants in terms of water potential, solute potential and turgor potential
- describe transpiration in higher plants
- describe root water uptake in higher plants
- explain water flow across plant tissues and through xylem vessels

### Assessment guidelines

This Outcome could be assessed by extended response, restricted response or short answer questions under closed-book supervised conditions that allow the candidate to use correct terminology to describe and explain the botanical processes.
The assessment for this Outcome may be combined with one or more other Outcomes.

## Outcome 4

### Explain the absorption and translocation of nutrient ions by plants

### Knowledge and/or skills

- Absorption of nutrient ions by root cells
- Movement of nutrient ions from roots to shoots and their redistribution

### Evidence Requirements

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

- explain the absorption of nutrient ions by root cells
- explain the movement of nutrient ions from roots to shoots and their redistribution

### Assessment guidelines

This Outcome could be assessed by extended response, restricted response or short answer questions under closed-book supervised conditions that allow the candidate to explain the absorption and translocation of nutrient ions by plants. The assessment for this Outcome may be combined with one or more other Outcomes.

## Administrative Information

**Unit code:** **F1MS 34**

**Unit title:** Plant Physiology

**Superclass category:** RH

**Original date of publication:** July 2008

**Version:** 01

**History of changes:**

| Version | Description of change | Date |
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**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: Plant Physiology

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

The aim of this Unit is to provide students with knowledge and understanding of the physiological processes involved in plant growth. It provides the foundation for more advanced Units examining crop physiology at the canopy level, the molecular and biochemical basis of plant growth and plant-environment interactions. Understanding the processes underlying plant growth is an important foundation for a career in crop production, plant science, biotechnology or horticulture.

This Unit explains the basic physiology of the fundamental processes on which plant growth is based, and includes cellular mechanisms as well as processes at the whole plant level.

Corresponding to Outcomes:

**Outcome1**: Explain the mechanism of photosynthesis.

This Outcome considers the importance of photosynthesis in terms of carbon fixation, energy capture, and plant dry matter production. Net photosynthesis is explained in terms of leaf carbon dioxide exchange as the balance between gross photosynthesis, photorespiration and respiration. The light reactions and biochemistry of photosynthesis are introduced, and the major modifications to the basic photosynthetic process are described and related to plant climatic adaptation.

**Outcome 2**: Describe the transport and partitioning of assimilates in plants.

Having studied the photosynthetic production of dry matter in the first Outcome, students now consider the fate of the resulting assimilates. The pathways and mechanism for assimilate transport around plants are examined. Assimilate partitioning and its significance for plant growth form and crop yields are explained in terms of sources, sinks and relative sink strength. The harvest index and its importance for crop yields and breeding may be discussed.

**Outcome 3**: Describe the flow of water through plants and tissues;

This Outcome begins with a consideration of the water relations of individual cells. Aquaporins and transmembrane water movement are discussed, and the water relations of plant cells are explained in terms of water potential, solute potential and turgor potential. Intercellular movement and the apoplastic, symplastic and transcellular routes of water flow across selected tissues are described. The driving forces and pathways for root water uptake, xylem water transport and transpirational water loss are explained. Factors affecting root water uptake and transpirational loss are related to plant water balance, and the effects of plant water deficit are outlined.

## Higher National Unit specification: support notes (cont)

## Unit title: Plant Physiology

**Outcome 4**: Explain the absorption and translocation of nutrient ions by plants.

This Outcome is taught with reference to the importance of mineral ions in the maintenance of plant cell function. The Outcome begins by examining membrane transport processes, and the absorption of nutrient ions by root cells. Students then consider the transport of mineral ions across the root, into the root xylem and on to the shoot, and their incorporation into cell structures. The subsequent redistribution and recycling of minerals around the plant are also examined.

## Guidance on the delivery and assessment of this Unit

The Unit may be taught through a series of lectures complemented by support notes and published materials. Demonstrations and experiments that examine photosynthesis, transpiration, gas exchange, dry matter, cell water relations etc. would enhance the learning experience.

Workbooks covering all topics may be completed by candidates using published materials and Course teaching materials to demonstrate correct use and application of terminology and principles of plant science.

## Higher National Unit specification: support notes (cont)

## Unit title: Plant Physiology

### Assessment

Assessment can reflect the teaching/learning approach taken by a particular centre.
Assessment would normally be closed-book and held under supervision.
Assessment would normally be based on short answer or restricted response or extended response questions sampling the content listed in the knowledge and/or skills section.
Each Outcome may be assessed separately or combined with others reflecting the teaching/learning approach.

***Opportunities for developing Core Skills***

There are opportunities to develop the Core Skill(s) of Numeracy at Higher level in this Unit, although there is no automatic certification of Core Skills or Core Skills components

## Open learning

Given the largely theoretical nature of this Unit it may be possible to deliver via Open or Distance learning. Every effort should be made to ensure the validity of evidence and assessment.

## 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:** Plant Physiology

The Unit aims to provide the candidate with an understanding of the science underlying many of the systems involved in the function of higher plants. It also provides underpinning knowledge for those intending to pursue more advanced studies in plant science.

During the Course of the Unit candidates study the chemistry, physics and biology of photosynthesis, water transport, nutrient absorption and translocation, materials transport and assimilation in higher plants.

You will normally be assessed in this Unit through a combination of short answer, restricted response and extended response questions carried out under closed-book supervised conditions.