



## Higher National Unit specification

### General information for centres

**Unit title:** Microorganisms: Growth, Activity and Significance

**Unit code:** F21L 34

**Unit purpose:** This Unit will equip candidates with a basic knowledge and understanding about microorganisms and their significance. It will introduce the major groups, factors affecting growth and also indicate some of the beneficial and harmful activities of microbes. The Unit will take a practical lab-based approach and has been produced in a generic way so as to allow the targeting of types of microbes and their activities which are of particular importance to the context in which the Unit may be delivered ie environmental science, food science, animal science, plant science or biotechnology. It is primarily intended for candidates who intend to pursue a career within the land-based sector in careers which require the application of applied biological sciences.

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

- 1 Perform basic microbiology laboratory procedures.
- 2 Describe microbial growth and the factors that affect microbial growth and survival.
- 3 Explain the significance of the interactions of microbes with specific habitats.

**Credit points and level:** 1 HN credit 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 centre, however it would be advantageous for candidates to have studied biological subjects at SCQF level 5 or 6 or equivalent or have completed the Unit, DJ1K 34 *Cell Biology: Theory and Practice*. Although the essential knowledge and skills for microbiology laboratory safety will be taught during Outcome 1, previous study of a Unit dealing with Health and Safety, such as DF82 34 *Quality and Health and Safety Systems in Science Industries*, will help to put these safe working procedures into context.

**Core Skills:** There are many opportunities to develop Core Skills in this Unit, although there will be no automatic certification of Core Skills or Core Skill components. The Core Skill components 'oral or written Communication' of the Core Skill Communication and Numeracy skills at SCQF level 6 could be developed in this Unit. The Core Skill components 'Critical Thinking and Planning and Organising' of the Core Skill Problem Solving and the Core Skill Working with Others could also be developed, both at SCQF level 5.

## General information for centres (cont)

**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. This Unit is appropriate for any land-based, biological or environmental Group Award

**Assessment:** For Outcome 1, a practical approach is adopted with checklists generated to cover the practical elements and a report produced to ensure that evidence for each of the Knowledge and/or skills items is collected. When assessing Outcomes 2 & 3 single assessment tasks could be undertaken although an integrated approach could be adopted. This could take the form of a closed-book assessment under supervised conditions, with evidence being provided on a sample basis.

## **Higher National Unit specification: statement of standards**

**Unit title:** Microorganisms: Growth, Activity and Significance

**Unit code:** F21L 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**

Perform basic microbiology laboratory procedures

#### **Knowledge and/or Skills**

- ◆ Safe laboratory procedures
- ◆ Aseptic techniques
- ◆ Habitats
- ◆ Detection methods for microorganisms
- ◆ Microbial identification
- ◆ Major microbial groups
- ◆ Microbial load

#### **Evidence Requirements**

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

- ◆ perform safe microbiology laboratory procedures incorporating good aseptic technique
- ◆ perform two methods for the detection of microbes in habitats
- ◆ perform three methods for the identification of microbes
- ◆ describe characteristics of five major microbial groups
- ◆ perform a procedure to assess the microbial load in a habitat

This Outcome should be assessed by three practical laboratory experiments and one report. Checklists should be used to record evidence that practical techniques have been performed safely and incorporate safe laboratory procedures. The candidate should complete a report which should aim to cover the knowledge base for the Outcome not covered by the practical experiments.

#### **Assessment Guidelines**

Each practical experiment may be constructed differently to allow for all practical and theory evidence items to be undertaken.

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

**Unit title:** Microorganisms: Growth, Activity and Significance

### **Outcome 2**

Describe microbial growth and the factors that affect microbial growth and survival

#### **Knowledge and/or Skills**

- ◆ Chemical requirements for microbial growth
- ◆ Environmental factors affecting growth
- ◆ Manipulation of habitat
- ◆ Microbial reproduction
- ◆ Bacterial growth curve

#### **Evidence Requirements**

Evidence for this Outcome will be generated through sampling. Three of the five Knowledge and /or Skills items must be sampled on each assessment occasion.

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 to prevent the candidate being able to predict what they will be asked.

Candidates will need to provide evidence to demonstrate their knowledge and understanding of the growth and survival of microbes and the factors affecting them.

Where an item is sampled, a candidate's response will be judged to be satisfactory when the evidence provided shows that the candidate can:

- ◆ describe the chemical requirements for microbial growth in terms of six primary elements, two mineral, two trace elements and two complex organic growth factors
- ◆ describe six environmental factors that affect microbial growth
- ◆ describe, giving an example for each, how (i) the physical environment and (ii) chemical factors in the habitat can be manipulated to affect the growth or survival of microbes
- ◆ describe the three main patterns of microbial reproduction
- ◆ describe the stages in the bacterial growth curve

The assessment should be unseen and conducted under closed-book, supervised conditions.

#### **Assessment Guidelines**

Assessment of this Outcome provides the opportunity to combine with the assessment for Outcome 3 by using a single integrated assessment containing restricted response questioning with an assessment time of 60 minutes advisable.

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

**Unit title:** Microorganisms: Growth, Activity and Significance

### **Outcome 3**

Explain the significance of the interactions of microbes with specific habitats

#### **Knowledge and/or Skills**

- ◆ Beneficial interactions with animals and plants
- ◆ Pathogenicity
- ◆ Microbes in food
- ◆ Microbes in soil and water
- ◆ Production of useful products

#### **Evidence Requirements**

Evidence for this Outcome will be generated through sampling. Three of the five Knowledge and/or Skills items must be sampled on each assessment occasion.

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 to prevent the candidate being able to predict what they will be asked.

Candidates will need to provide evidence to demonstrate their knowledge and understanding of the significance of microorganisms in specific habitats.

Where an item is sampled, a candidate's response will be judged to be satisfactory when the evidence provided shows that the candidate can:

- ◆ explain two examples of beneficial interactions with animals and plants
- ◆ explain pathogenicity in terms of communicability, infectivity and virulence
- ◆ explain one beneficial and two harmful roles of microbes in foods
- ◆ explain two major roles of microbes in organic degradation and nutrient cycling in soil and water
- ◆ explain the potential of microbes in the manufacture of two current products

The assessment should be unseen and conducted under closed-book, supervised conditions.

#### **Assessment Guidelines**

Assessment of this Outcome provides the opportunity to combine with the assessment for Outcome 2 by using a single integrated assessment containing restricted response questions with a recommended assessment time of 60 minutes.

## Administrative Information

**Unit code:** F21L 34

**Unit title:** Microorganisms: Growth, Activity and Significance

**Superclass category:** RH

**Original date of publication:** September 2007

**Version:** 01

### History of changes:

Version	Description of change	Date

**Source:** SQA

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## Higher National Unit specification: support notes

### Unit title: Microorganisms: Growth, Activity and Significance

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 is intended for candidates who are studying for a Group Award such as HND Applied Bioscience, HND Agricultural Science or HND Green Technology and could be used in other land-based science Courses such as Poultry, Food and Horticulture.

It is primarily intended for candidates who intend to pursue a career within the land-based sector in careers which require the application of applied biological sciences. It aims to equip such candidates with a basic understanding about microorganisms and their significance. During the practical laboratory sessions candidates will work with and be familiarised with some of the groups of microbes, which are most important within the context of delivery. Candidates will also learn some of the methods used to distinguish between microbial groups, investigate microbial growth and how we can seek to control it and examine the significance of microorganisms in some selected habitats.

**Outcome 1** is designed to give the candidate a basic grasp of the safe methods used to detect, describe and identify microorganisms and to assess the microbial load in a habitat using methods such as:

- ◆ Aseptic technique: aseptic transfers; streak, spread and pour plates inoculations
- ◆ Detection of microbes: microscopy techniques, culturing techniques, detection by chemical activity
- ◆ Habitats: detection of microbes in appropriate habitats using methods as above
- ◆ Identification: wet mounts, gram stains, selective culturing, differential agars
- ◆ Microbial groups: yeasts, moulds, protozoa, algae and some bacterial groups
- ◆ Assessing microbial load: such as viable counting techniques or chemical activity

**Outcome 2** provides a basic knowledge and understanding about microbial growth.

- ◆ Chemical requirements: primary nutrients, minerals, trace elements, organic growth factors
- ◆ Environmental factors: moisture, temperature, oxygen, pH, radiations, antimicrobial agents
- ◆ manipulation: eg relevant examples and the use of heat to kill microbes
- ◆ growth/reproduction: bacteria, yeast, mould
- ◆ growth curve: exponential, logarithmic transformation on graph paper, interpret phases: lag, log, stationary, death

**Outcome 3** is designed to explain the significance of the interactions of microbes in specific habitats.

- ◆ Beneficial interactions: commensalism, mutualism
- ◆ Pathogenicity: communicability, infectivity, virulence
- ◆ Microbes in foods: food fermentation, food spoilage, food poisoning

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

### Unit title: Microorganisms: Growth, Activity and Significance

- ◆ Microbes in soil and water: organic breakdown and recycling of minerals for plant growth
- ◆ Microbes in production: exemplifying their growing role in biotechnology

### Guidance on the delivery and assessment of this Unit

This Unit is intended for candidates who are studying for a Group Award in such as HND Applied Bioscience, HND Agricultural Science, or HND Green Technology. It aims to equip such candidates with a basic understanding about microorganisms and their significance in the context of their chosen Course.

This SCQF level 7 Unit is intended to be delivered during the first year programme of a science Course or Group Award at a point where the candidate will have some basic knowledge about the nature and functioning of biological molecules, cells and organisms. Independent study will be encouraged, for example in the candidate's reading, for the reports used for assessment in Outcome 1.

Assessment of Outcomes 2 and 3 uses sampling and could be combined into one integrated assessment.

#### *Opportunities for developing Core Skills*

There are many opportunities to develop Core Skills in this Unit, although there will be no automatic certification of Core Skills or Core Skill components.

The Core Skill Communication at SCQF level 6 could be developed in this Unit because of the requirement to produce reports of practical experiments and articulate results. Numeracy skills at SCQF level 6 may be developed during experiments involving calculations of viable counts and the construction and interpretation of graphs showing the logarithmic nature of microbial growth. Several practical exercises including the prolonged monitoring and evaluation of microbial growth should involve group work thus enabling the development of the Core Skill 'Working with Others' at SCQF level 5.

Also the Core Skill components Critical Thinking and Planning and Organising of the Core Skill Problem Solving at SCQF level 5 could be developed during the planning, execution and reporting of the practical experiments.

### Open learning

This Unit could be only partially delivered by distance learning. The practical element would require supervised instruction over several sessions. Delivery using distance learning would require careful planning by the centre to ensure both an adequate learning experience and the sufficiency and authenticity of candidate evidence.

### 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](http://www.sqa.org.uk)).



## General information for candidates

### Unit title: Microorganisms: Growth, Activity and Significance

This is a single credit Unit at SCQF level 7 intended for candidates in the first year of a biological science-related qualification. It is designed to equip you with basic knowledge and understanding about the types, growth and significant activities of microorganisms, particularly those relevant to land-based industries.

Much of what you learn in this Unit will be based around lab-based practical activities. You will learn about: the detection, handling and identification of microorganisms from relevant habitats; the growth of microbes and how this can be restricted and the beneficial and harmful roles of these microbes in our world. These skills and knowledge are intended to serve as a foundation to more specialised learning including animal and plant interactions with microbes, food hazards and spoilage and the uses of microorganisms in biotechnology.

On completion of this Unit you should be able to do the following three Outcomes:

- 1 Perform basic microbiology laboratory procedures.
- 2 Describe the growth of microbes and the factors that affect microbial growth and survival.
- 3 Explain the significance of the interactions of microbes with specific habitats.

For **Outcome 1** you will use some basic practical approaches for the detection, isolation, identification and description of some of the main microbial groups. From this you will learn the principles of the detection of microbes in their habitats. You will carefully use methods for the isolation, identification and description of microbes including aseptic techniques, microscopy, culturing and microbial counting and accurately record observations and report on these experiments. You must be able to describe features of the main groups of microbes sufficiently to make clear that you understand the differences between them.

For **Outcome 2** you will be required to describe the reproduction and growth of some important microbial groups and the consequences of microbial growth. You must be able to describe chemical and environmental factors required for growth and how these factors can be manipulated in some important habitats such as foods to encourage or inhibit the growth and survival of microbes. The pattern and stages of growth as seen in the batch growth of microbes will also be studied.

For **Outcome 3** you will learn about the nature and be required to explain the significance of some of the interactions between microorganisms and their habitats. Specifically you will study the following:

- ◆ examples of both beneficial and the harmful interactions of microbes with animals and plants, including mutualism, commensalism and pathogenicity
- ◆ the beneficial and harmful roles of microbes in food
- ◆ the roles of microbes in organic degradation and nutrient cycling in soil and water
- ◆ the potential of microbes in the making of products useful to mankind

The Core Skill of `Communication` at SCQF level 6 could be developed in this Unit because of the requirement to produce reports of practical experiments. Also the Core Skill of Problem Solving at SCQF level 5 could be developed during the planning, execution and reporting of the practical experiments. Numeracy skills at SCQF level 6 could be developed during experiments involving calculations of viable counts. Several practical exercises including the prolonged monitoring and evaluation of microbial growth should involve group work thus enabling the development of the Core Skill, Working With Others at SCQF level 5.