



## Higher National Unit specification

### General information for centres

**Unit title:** Microbiology: Theory and Practice

**Unit code:** DH55 34

**Unit purpose:** The purpose of this Unit is to provide candidates with a sound understanding of the types, distribution and significance of micro-organisms. The Unit will provide fundamental knowledge regarding the major microbial groups which candidates are likely to encounter within the biotechnology industry. This Unit is primarily intended for candidates who propose to pursue a science based career in a field which requires an understanding of microbiology.

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

1. Describe the major microbial groups and their applications in biotechnology processes.
2. Explain the effect of biotic and abiotic factors on microbial growth and death.
3. Describe the significance of micro-organisms in specific natural habitats.
4. Perform microbiological techniques.

**Credit value:** 2 HN credits at SCQF level 7: (16 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 will be at the discretion of the centre, however, it is recommended that candidates should have studied Standard Grade Credit or Intermediate 2 Biology.

**Core Skills:** There may be opportunities to gather evidence towards the Core Skill in Numeracy at higher level in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

**Context for delivery:** This Unit is included in the framework of the Group Awards, HNC Applied Sciences and HND Biotechnology. It is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

## General information for centres (cont)

**Assessment Guidelines:** ~~It is recommended that this Unit is assessed by a single end-of-Unit assessment and laboratory practicals although it could be assessed on an Outcome by Outcome basis. The end of Unit assessment, covering Outcomes 1-3, would take the form of questions as detailed in the evidence requirements. In outcome 4, where practical skills are assessed, evidence could be recorded in the form of a checklist to demonstrate good laboratory technique and by completing laboratory reports. Candidates must meet the level of performance specified in the evidence requirements for the Unit after the outcomes to achieve the Unit.~~

Outcomes 1-3 should be assessed by a closed-book, holistic, supervised assessment with a cut off score of 60%. In Outcome 4, where practical skills are assessed, evidence should be recorded in the form of a checklist to demonstrate good laboratory techniques and by completing a laboratory log book.

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

**Unit title:** Microbiology: Theory and Practice

**Unit code:** DH55 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**

Describe the major microbial groups and their applications in biotechnology processes.

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

- ◆ Bacteria
- ◆ Fungi
- ◆ Protista
- ◆ Viruses and sub-viral particles
- ◆ Biotechnology processes

#### **Evidence Requirements**

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

- ◆ describe the major morphological and physiological characteristics of bacteria
- ◆ describe the major morphological and physiological characteristics of fungi
- ◆ describe the major morphological and physiological characteristics of protista
- ◆ describe the major morphological and physiological characteristics of viruses and sub-viral particles
- ◆ describe the applications of selected microbial groups in biotechnology processes

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

**Unit title:** Microbiology: Theory and Practice

### **Outcome 2**

Explain the effect of biotic and abiotic factors on microbial growth and death.

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

- ◆ Microbial reproduction mechanisms
- ◆ Biotic and abiotic factors which influence microbial growth and death
- ◆ Bacterial growth curve
- ◆ Significance and use of aseptic technique

#### **Evidence Requirements**

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

- ◆ describe the mechanisms of reproduction in the major microbial groups
- ◆ identify the factors which can influence microbial growth and death
- ◆ explain the way in which the factors influencing growth exert their effect
- ◆ name the phases of a bacterial growth curve and explain the events which occur during growth
- ◆ discuss the use and importance of aseptic technique in relation to microbial growth.

### **Outcome 3**

Describe the significance of micro-organisms in specific natural habitats.

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

- ◆ Microbiology of soil
- ◆ Microbiology of water
- ◆ Microbiology of the human body

#### **Evidence Requirements**

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

- ◆ describe the distribution and roles of specific micro-organisms in soil ecosystems
- ◆ describe the distribution and roles of specific micro-organisms in aquatic ecosystems
- ◆ describe the role and significance of the natural flora and pathogenic micro-organisms of the human body

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

**Unit title:** Microbiology: Theory and Practice

### Assessment Guidelines for the Unit

It is recommended that a holistic assessment ~~at the end of the Unit~~ is given to the candidate for Outcomes 1–3. This assessment ~~could~~ should be a closed-book assessment carried out under supervised conditions ~~of approximately two hours duration, with a cut off score of 60%.~~ This closed-book assessment could take the form of a set of structured questions and restricted responses to test the candidate's knowledge and understanding.

Evidence for the knowledge and/or skills for these Outcomes will be provided on a sample basis and should include a representative range of questions to reflect the knowledge and/or skills items listed under the Evidence Requirements. Four of the knowledge and/or skills items from Outcome 1 should be sampled (three of the microbial groups in addition to biotechnology processes), three of the knowledge and/or skills items from Outcome 2 should be sampled and two of the knowledge and/or skills items from Outcome 3 should be sampled.

### Outcome 4

Perform microbiological techniques.

#### Knowledge and/or Skills

- ◆ Experiments are performed using aseptic technique
- ◆ Preparation and identification of microbial samples
- ◆ Growth of micro-organisms
- ◆ Control of microbial growth by physical and/or chemical methods

#### Evidence Requirements

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

- ◆ perform microbiological techniques using good aseptic technique
- ◆ prepare slides of micro-organisms
- ◆ use staining techniques
- ◆ use quantitative and/or qualitative methods to demonstrate microbial growth
- ◆ apply physical and/or chemical methods to remove and inhibit microbial growth

~~Evidence for the knowledge and/or skills for these outcomes will be provided on a sample basis and should include a representative range of questions to reflect the knowledge and/or skills items listed under the evidence requirements. Four of the knowledge and/or skills items from Outcome 1 should be sampled (three of the microbial groups in addition to biotechnology processes), three of the knowledge and/or skills items from Outcome 2 should be sampled and two of the knowledge and/or skills items from Outcome 3 should be sampled.~~

### Assessment Guidelines

This Outcome ~~could~~ should be assessed by ~~four~~ laboratory based practical experiments. Candidates should complete ~~four laboratory reports and~~ a laboratory log book. ~~The four reports which~~ should, ~~between them,~~ cover all of the areas listed in knowledge and/or skills for the Outcome. A checklist ~~could~~ should be used to generate evidence that practical techniques have been performed to a satisfactory standard.

## Administrative Information

**Unit code:** DH55 34

**Unit title:** Microbiology: Theory and Practice

**Superclass category:** RH

**Original date of publication:** August 2004

**Version:** 03 (June 2009)

### History of changes:

Version	Description of change	Date
02	Amendment to Assessment Guidelines for Outcome 3.	11/07
03	Changes made to standardise assessment guidelines.	03/06/09

**Source:** SQA

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## Higher National Unit specification: support notes

### Unit title: Microbiology: Theory and Practice

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 80 hours.

### Guidance on the content and context for this Unit

This Unit is primarily intended to provide candidates with a fundamental understanding of the range of micro-organisms which exists, the roles of specific micro-organisms in nature, the methods used to control micro-organisms and the manner in which specific micro-organisms can be exploited in industry. This Unit will provide knowledge essential to the understanding of subsequent microbiology studies by candidates such as the second year HN Unit - Microbiological Techniques: Theory and Practice.

**Outcome 1** looks at the structure and biotechnological exploitation of the major microbial groups:

- ◆ Bacteria: morphology; cellular structure and function
- ◆ Fungi: morphology; cellular structure and function,
- ◆ Protists: morphology; cellular structure and function
- ◆ Viruses: morphology; sub-viral particles (prions and viroids) structure
- ◆ Biotechnology processes: fermentations; recombinant DNA techniques; bioremediation; sewage treatment; cloning vectors

**Outcome 2** covers the effect of biotic and abiotic factors which influence microbial growth:

- ◆ Reproduction mechanisms: bacteria; fungi; protists; viruses; prions
- ◆ Growth curve: growth phases; doubling time; growth kinetics
- ◆ Factors which influence growth: temperature; pH;  $A_w$ ; nutrients; hydrostatic pressure,  $O_2$  concentration
- ◆ Aseptic technique: subculturing; safety cabinets; clean rooms; good laboratory practice

**Outcome 3** covers the distribution and role of specific micro-organisms in natural ecosystems:

- ◆ Soil: microhabitats; nutrient cycling; soil formation; soil structure maintenance; microbial interactions; pathogens
- ◆ Water: stratification; nutrient cycling; eutrophication; pathogens
- ◆ Human body: natural flora; pathogens

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

### Unit title: Microbiology: Theory and Practice

**Outcome 4** requires the candidate to utilise a range of techniques to study the structure, growth and distribution of micro-organisms.

- ◆ Aseptic technique: aseptic transfers; spread plates; pour plates; streak plates
- ◆ Microbial samples: Gram stain; fungal slide cultures; protista samples; bacteriophage plaque assay
- ◆ Bacterial growth: viable count; bacterial growth curve; total count; selective media
- ◆ Control of micro-organisms: radiant plate; antibiotic assay; Kelsey-Sykes dilution test for disinfectants; membrane-filtration; autoclaves

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

This Unit is designed to form part of the Group Award, HNC Applied Sciences and HND Biotechnology. It is designed to introduce candidates to basic microbiology theory and practical skills. Candidates should preferably have some background in studying biology.

Assessment of Outcomes 1-3 could be a holistic, closed-book ~~end-of-Unit~~ assessment. Evidence should be generated on a sample basis for each Outcome.

Outcome 4 should be assessed by laboratory based experiments. Assessment of practical skills should be ~~by evidenced of by a checklist and completion of a log book,s, laboratory reports and/or checklists.~~ Where evidence for this Outcome is unsatisfactory, candidates may be questioned in order to identify particular problems within a specific area. ~~During remediation only the unsatisfactory section(s) need be re-assessed.~~

### Open learning

The theory component of this Unit could be delivered by distance learning methods however in order to carry out the practical component candidates would have to attend the centre.

If the theory for this Unit is delivered by open or distance learning methods, additional planning resources may be required for candidate support, assessment and quality assurance.

A combination of new and traditional authentication tools may have to be devised for assessment and re-assessment purposes.

### Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any

reasonable adjustments may be required. Further advice can be found on our website  
**[www.sqa.org.uk/assessmentarrangements](http://www.sqa.org.uk/assessmentarrangements)**

## General information for candidates

### Unit title: Microbiology: Theory and Practice

This 2 credit HN Unit at SCQF level 7 is intended for candidates undertaking the Group Awards, HNC Applied Sciences and HND Biotechnology. It is designed primarily for candidates who already have previous experience of studying biological sciences at Higher level.

This Unit will provide you with a fundamental introduction to the major groups of micro-organisms, their beneficial and harmful roles in nature, the mechanisms they utilise to reproduce and how their growth can be inhibited or eliminated from materials. The material in this Unit will also touch upon the industrial exploitation of specific micro-organisms as a precursor to the study of specific biotechnology processes in subsequent Units within the Group Awards, HNC Applied Sciences and HND Biotechnology. You will also gain practical experience in the basic techniques utilised to carry out microbiological experiments safely and accurately and learn some basic identification, quantification and assay techniques.

In order to successfully complete this Unit you will have to:

- ◆ Describe the major microbial groups and their roles in biotechnology processes. You will cover topics such as the production of fermented foods and beverages utilising fungi, the role of bacteria in cleaning contaminated soil and the use of viruses in genetic engineering. Background information detailing the structure and general characteristics of each type of organism will also be taught.
- ◆ Explain microbial growth and the factors which influence it. You will learn how factors such as temperature, pH, water availability, nutrient availability and pressure affect the growth of microorganisms. The methods of sexual and asexual reproduction encountered in different groups of micro-organisms will also be detailed. Methods employed to control or eliminate growth will be covered and their application in the food industry, hospitals and other environments.
- ◆ Describe the distribution and significance of micro-organisms in specific natural habitats. You will learn about the types of micro-organisms found in soil, water and the human body and their roles within these systems.
- ◆ Perform fundamental microbiological techniques. You will receive practical experience in many of the basic skills required to perform microbiological studies safely and accurately. Laboratory sessions will cover the use of good aseptic techniques and the isolation, observation and identification of different groups of micro-organisms. Experiments charting microbial growth and demonstrating the effects of anti-microbial compounds and other chemical and physical methods of controlling microbial growth will also be carried out.

The delivery of this Unit will be on the basis of lectures, tutorials and practical sessions.

## General information for candidates (cont)

**Unit title:** Microbiology: Theory and Practice

Your knowledge and skills acquired in this Unit will be tested by production of ~~written~~ evidence ~~produced~~ through ~~an end-of-Unit~~ a closed-book, holistic assessment. In Outcome 4 practical skills will be assessed by laboratory-based-experiments, log books, ~~laboratory reports~~ and a checklists.

You must achieve a satisfactory level of performance in all assessments in order to achieve this Unit.