



Higher National Unit specification

General information

Unit title: Microbiology: Theory and Laboratory Skills (SCQF level 7)

Unit code: H92G 34

Superclass: RH

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Version: 01

Unit purpose

This Unit is designed to enable learners to understand key aspects of micro-organisms, the different habitats they are found in, and their beneficial and detrimental effects. Learners will also develop practical skills in techniques relevant to microbiology. The Unit is suitable for learners studying at HNC level, and will provide the necessary underpinning knowledge and skills to enable progression to further study of microbiology at HND level or to seek employment in science based industries.

Outcomes

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

- 1 Describe and explain aspects of prokaryotic micro-organisms.
- 2 Describe and explain aspects of eukaryotic micro-organisms.
- 3 Describe and explain aspects of akaryotic micro-organisms.
- 4 Perform practical experiments related to microbiology.

Credit points and level

2 Higher National Unit credits at SCQF level 7: (16 SCQF credit points at SCQF level 7)

Recommended entry to the Unit

Entry is at the discretion of the centre, however it is recommended that learners should have completed the HN Unit H927 34 *Cell Biology: Theory and Laboratory Skills* or equivalent, or have experience of Biology at Higher level.

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.

The Assessment Support Pack (ASP) for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website (<http://www.sqa.org.uk/sqa/46233.2769.html>).

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

Describe and explain aspects of prokaryotic micro-organisms.

Knowledge and/or Skills

- ◆ Cellular structure
- ◆ Method of reproduction
- ◆ Growth requirements
- ◆ Natural habitats
- ◆ Beneficial effects (direct and indirect)
- ◆ Detrimental effects (direct and indirect)

Outcome 2

Describe and explain aspects of eukaryotic micro-organisms.

Knowledge and/or Skills

- ◆ Cellular structure
- ◆ Method of reproduction
- ◆ Growth requirements
- ◆ Natural habitats
- ◆ Beneficial effects (direct and indirect)
- ◆ Detrimental effects (direct and indirect)

Outcome 3

Describe and explain aspects of akaryotic micro-organisms.

Knowledge and/or Skills

- ◆ Non-cellular structure
- ◆ Method of replication
- ◆ Growth requirements
- ◆ Natural habitats
- ◆ Beneficial effects (direct and indirect: viruses only)
- ◆ Detrimental effects (direct and indirect)

Higher National Unit specification: Statement of standards (cont)

Unit title: Microbiology: Theory and Laboratory Skills (SCQF level 7)

Outcome 4

Perform practical experiments related to microbiology.

Knowledge and/or Skills

- ◆ Microbiology experiments
- ◆ Working safely, within current health and safety regulations
- ◆ Consistent and accurate results
- ◆ Recording observations and results
- ◆ Evaluation skills
- ◆ Result analysis and conclusions

Evidence Requirements for this Unit

Written and/or oral recorded evidence for Outcomes 1–3 should be assessed using a holistic closed-book assessment under supervised conditions. The assessment will use a sampling approach to the Knowledge and/or Skills as detailed below. It is recommended that the assessment be completed within 90 minutes.

Written and/or oral recorded evidence for Outcome 4 should be assessed by production of a full laboratory report, or by completion of an appropriate pro forma/appropriate laboratory book entry. An assessor's observation checklist could be used to record performance evidence of practical experiments.

Outcome 1

The assessment will sample four of the six Knowledge and/or Skills items. Learners will not have prior knowledge of which items are being assessed. Those items which are not sampled must be covered in the alternative (re-sit) assessment.

Where an item is sampled, a learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ Describe cell structure of prokaryotic microbes.
- ◆ Describe binary fission.
- ◆ Describe the phases of bacterial growth and explain the effects of manipulating environmental conditions on growth.
- ◆ Describe the occurrence of bacteria in natural habitats using specific examples.
- ◆ Describe and explain the beneficial effects (direct and/or indirect) of bacteria using named examples.
- ◆ Describe and explain the detrimental effects (direct and/or indirect) of bacteria using named examples.

Higher National Unit specification: Statement of standards (cont)

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Outcome 2

The assessment will sample four of the six Knowledge and/or Skills items. Learners will not have prior knowledge of which items are being assessed. Those items which are not sampled must be covered in the alternative (re-sit) assessment.

Where an item is sampled, a learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ Describe cell structure of eukaryotic microbes.
- ◆ Describe (asexual and/or sexual) routes of reproduction and structures involved.
- ◆ Predict and explain the effects of manipulating environmental conditions on growth.
- ◆ Describe the occurrence of eukaryotic microbes in natural habitats using specific examples.
- ◆ Describe and explain the beneficial effects (direct and/or indirect) of eukaryotic microbes using named examples.
- ◆ Describe and explain the detrimental effects (direct and/or indirect) of eukaryotic microbes using named examples.

Outcome 3

The assessment will sample four of the six Knowledge and/or Skills items. Learners will not have prior knowledge of which items are being assessed. Those items which are not sampled must be covered in the alternative (re-sit) assessment.

Where an item is sampled, a learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ Define akaryotic microbes by describing and explaining their structure.
- ◆ Describe replication mechanisms of viruses and/or sub-viral particles.
- ◆ Describe and explain growth requirements of akaryotes.
- ◆ Describe the occurrence of akaryotes in natural habitats using specific examples.
- ◆ Describe and explain the beneficial effects (direct and/or indirect) of viruses using named examples.
- ◆ Describe and explain the detrimental effects (direct and/or indirect) of akaryotes using named examples.

It should be noted however that 'beneficial effects' is not relevant to sub-viral particles so could not be assessed in this context.

Higher National Unit specification: Statement of standards (cont)

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Outcome 4

Learners will perform a range of practical activities and a minimum of two assessed practical experiments, the content of which should cover counting techniques and investigating the effects of environmental factors on growth, or an alternative experiment of an equal level of technical difficulty. A learner's response will be judged satisfactory where the evidence shows that the learner can achieve all of the following:

- ◆ Follow instructions to perform experiments related to microbiology.
- ◆ Work in a safe manner regarding current health and safety regulations.
- ◆ Achieve consistent and accurate results.
- ◆ Record experimental observations and results clearly and accurately.
- ◆ Evaluate validity of results in terms of sources of and values of experimental errors.
- ◆ Analyse results correctly and state valid conclusions.

An assessor observation checklist will be used to record the learner's performance of the practical work in line with given instructions and health and safety requirements.

Learners may report results either by production of a full laboratory report, or by completion of an appropriate pro forma/appropriate laboratory book entry. Where a pro forma approach is deployed, the pro forma will not present information or assistance to the learners on how to correctly perform calculations, analyse experimental results or experimental errors. Learners will be expected to perform such activities independently on the basis of the experimental data.

Where a learner does not perform an assessed practical activity to the required standard, they will be given the chance to either reattempt the same practical activity, or to undertake a different practical activity of similar complexity. Where a laboratory report or pro forma does not meet required standard, then the learner will be given a single opportunity to re-draft. If the required standard is still not attained, then an alternative practical activity will be set.



Higher National Unit Support Notes

Unit title: Microbiology: Theory and Laboratory Skills (SCQF level 7)

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 is intended as part of the framework for HNC/HND Applied Sciences, HND Applied Biological Sciences and HND Applied Chemical Sciences but may be suitable for inclusion in other HN Science awards. It is designed to develop the theoretical and practical aspects of microbiology.

Outcome 1 — Describe and explain aspects of prokaryotic micro-organisms

- ◆ Prokaryotes as exemplified by eubacteria. Lack of membrane bound organelles including nucleus but presence of cell wall, cell membrane, ribosomes, chromosome and nucleoid, to include appropriate function of each. Occurrence of plasmids, fimbriae and capsules, to include description of function. Cocci, bacilli, vibrio and spirilla, with understanding of prefixes to include staph-, strep- and diplo-. Gram positive and negative reactions in relation to cell wall structure.
- ◆ Binary fission to include asexual nature, basic principles and production of genetically identical bacteria.
- ◆ Phases of growth to include Lag and Death. Production of endospores. Effects of physical factors (temperature and pH) and chemical factors (to include nutrients, oxygen and antibacterials) on bacteria. Bacteriocidal and bacteriostatic.
- ◆ Bacteria in/on human body to include named members of natural flora. Presence in soil and water using named examples. Presence on surfaces (eg kitchen worktops, mobile phones and door handles).
- ◆ Beneficial effects to include natural processes utilising bacteria (eg cheese production), processes involving genetically modified bacteria (eg production of human growth hormone) and processes within the human body (eg vitamin K production by *E. Coli*).
- ◆ Detrimental effects to include named human diseases (variety of routes of transmission to include direct and indirect contact). Opportunistic pathogens. Indirect effects to include impact of bacterial infections of animals and plants on humans.

Higher National Unit Support Notes (cont)

Unit title: Microbiology: Theory and Laboratory Skills (SCQF level 7)

Outcome 2 — Describe and explain aspects of eukaryotic micro-organisms

- ◆ Eukaryotic, as exemplified by fungi, algae and protozoa, to contain membrane bound organelles including nucleus. Presence of cell wall (where relevant), cell membrane, nucleus, mitochondria, chloroplast (where relevant), vacuoles, rough ER and smooth ER, to include appropriate function of each. Occurrence and role of select structures to include flagella, cilia, pseudopodia and hyphae.
- ◆ Fungal reproduction to include asexual and sexual routes. Role of spores and fruiting bodies. Asexual spores exemplified by sporangiospores/sporangium. Process of budding. Sexual spores exemplified by zygospores. Algal reproduction to include binary fission and meiosis. Protozoan reproduction to include binary fission and conjugation.
- ◆ Effects of physical factors (temperature and pH) and chemical factors (to include nutrients, oxygen and antimicrobials) on growth. Cidal and static effects on growth.
- ◆ Fungi and protozoa in/on human body to include named members of natural flora. Protozoa and algae presence in soil and water using named examples. Presence of fungi on surfaces (eg kitchen worktops, mobile phones and door handles).
- ◆ Beneficial effects to include natural processes utilising fungi/algae/protozoa (eg penicillin production, role of protozoa in water purification and role of algae in carbon cycle).
- ◆ Detrimental effects to include named diseases (variety of routes of transmission to include direct and indirect contact). Opportunistic pathogens. Indirect effects to include impact of fungal infections of animals and plants on humans.

Outcome 3 — Describe and explain aspects of akaryotic micro-organisms

- ◆ Akaryotic as exemplified by viruses and sub-viral particles to lack cellular structure. Viral structure to include envelope, capsid, genetic material and key enzymes with role of each. Sub-viral particles to include RNA nature of viroids and satellites; protein nature of prions.
- ◆ Lytic cycle of viruses. Role of helper viruses in satellite replication. Autonomous nature of vioid replication. Induction of protein shape change with prions. Viruses as obligate parasites; requirements for host cells. Helper viruses.
- ◆ Effects of cidal and static agents on growth. Problems with controlling growth of viral and sub-viral particles.
- ◆ Viral presence in water using named examples. Presence of viruses on surfaces (eg kitchen worktops, mobile phones and door handles). Virion survival times outside of host cells.
- ◆ Beneficial effects to include processes utilising viruses (eg vaccines, bacteriophage therapy, role as vectors in molecular biology). Beneficial effects are not relevant to sub-viral particles.
- ◆ Detrimental effects to include named diseases (variety of routes of transmission) to include direct and indirect contact. Indirect effects to include impact of viral and sub-viral infections of animals and plants on humans.

Higher National Unit Support Notes (cont)

Unit title: Microbiology: Theory and Laboratory Skills (SCQF level 7)

Outcome 4 — Perform practical experiments related to microbiology

Guidance on suitable practical experiments for assessment purposes is given elsewhere in this document. However, it is envisaged that learners will also participate in a range of other practical experiments which will both develop their laboratory skills and support the theory covered in Outcomes 1-3.

In carrying out such activities, learners should follow good laboratory practice and carry out or be familiar with the risk and Control of Substances Hazardous to Health (COSHH) assessments on all procedures undertaken. Opportunities should be taken to develop awareness of the sources of experimental error and of the accuracy of measurements, with quantification of errors where possible.

Guidance on approaches to delivery of this Unit

There is no particular order in which Outcomes 1–3 would be best delivered. It is envisaged that laboratory work and demonstrations will feature across the delivery of each of the Outcomes, and that the assessed practical experiments will be undertaken in similar timeframe to the underpinning theory.

It is envisaged that delivery of Outcome 1 could commence with coverage of bacterial shape/arrangements and an understanding of prokaryotic cell structure. Practical experiments would play a large part of learning with microscopy and the study of electron micrographs being relevant at this stage. Learners need to develop competence in sub-culturing bacteria when covering bacterial growth and the factors that influence it. This could be introduced by the preparation of appropriate media and the importance of aseptic technique, but the topic lends itself to an investigative practical approach. Learners would be expected to develop an understanding of the cellular impact of moving to extremes of temperature, etc as well as a basic understanding of the different subdivisions of bacteria based on chemical requirements, eg autotrophs/heterotrophs and aerobes/anaerobes/facultative anaerobes/micro-aerophiles. The importance of antibacterial agents could cover antibiotics as well as disinfectants and antiseptics, but is important that learners understand the difference between agents that are bacteriostatic and those that are bacteriocidal.

It is recommended that learners are taught about symbiotic relationships in the human body and the occurrence of bacteria in other environments using selected examples rather than learning lists of microbes. The choice of example is important to reflect the variation in habitats (micro environments) and also the quantities that would be anticipated in these environments. This topic lends itself to practical experiments such as environmental sampling and testing of antibacterials, enabling learners to collect and analyse data based on microbial counts.

Beneficial effects and detrimental effects could include the opportunity for learners to select and research named examples. It is important that those examples selected reflect the direct and indirect effects on humans. Use of video footage could be effective to explain the effects of these microbes.

Higher National Unit Support Notes (cont)

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Outcome 2 is intended to cover similar themes to Outcome 1 but in relation to fungi and protists (algae and protozoa). It is recommended that a general introduction to eukaryotic cell structure is followed by subdividing the Outcome into topics on fungi, algae and protozoa, with the appropriate Knowledge and/or Skills being covered for each topic. Sub-culturing of both yeasts and moulds is encouraged as is the preparation of slides of all microbes (eg wet mounts of moulds and hanging drop suspensions of protozoa). The theory on reproduction of moulds can be supplemented by experiments sub-culturing compatible strains of *Mucor hiemalis*, whilst budding can be observed in yeast. Investigations of the effects of manipulating environmental conditions on growth provide an opportunity for learners to design experiments and develop problem solving skills.

Beneficial effects and detrimental effects could include the opportunity for learners to select and research named examples.

Outcome 3, by its nature, will offer fewer opportunities for practical work; the enumeration of viruses by plaque assay would therefore be encouraged. Research of the nature of sub-viral particles and their means of replication would provide an opportunity for learners to utilise IT skills to keep up to date with an evolving area of microbiology. The importance of antiviral agents should be covered, but is important that learners are aware of the inherent difficulties in developing agents that restrict viral reproduction without affecting the host cell.

Beneficial effects to viruses in medicine, biotechnology and research would provide learners with a breadth of examples, and the use of named diseases would help to illustrate the direct and indirect detrimental effects on humans.

Use of video footage could be effective to explain the effects of the microbes covered in Outcomes 1–3. Utilisation of learner IT skills for research and also for presentation of findings as display posters, information leaflets or by PowerPoint as part of an oral presentation would also be encouraged in Outcomes 1–3.

It is envisaged that Outcome 4 will be delivered alongside the theoretical based Outcomes 1–3. A range of practical activities could be utilised to both support understanding of the underlying theory and to prepare learners for undertaking the assessed practical experiments. Learners could complete a laboratory log book throughout the practical activity. Aspects suitable for experimental investigation should include counting techniques and investigating the effects of environmental factors on growth. Any alternative experiment must be of an equal level of technical difficulty.

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.

Outcomes 1–3 could be assessed by a single holistic closed-book assessment with an appropriate cut-off score that covers the sampling requirements as detailed in the Evidence Requirements. Assessment should be carried out in supervised conditions, and it is recommended that the assessment be completed within 90 minutes.

Higher National Unit Support Notes (cont)

Unit title: Microbiology: Theory and Laboratory Skills (SCQF level 7)

Where evidence of Outcomes 1–3 is assessed by sampling, the whole of the content listed in the Knowledge and/or Skills 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. Any items not sampled in the first assessment, must be included in the alternative (re-sit) assessment.

In Outcome 4 learners are required to undertake two assessed practical experiments, the content of which must involve counting techniques and investigation of the effects of environmental factors on growth, or a suitable alternative experiment of an equal level of technical difficulty. Examples of suitable activities to prepare learners for undertaking the assessed practical experiments are given below. However, this list is not prescriptive, and other practical activities of similar complexity may be used by the centre.

Suitable practical activities for Outcome 1 are:

- ◆ Preparation of fixed smears of Gram positive and negative bacteria, Gram staining and examination by oil immersion microscopy.
- ◆ Making nutrient agar, autoclaving and pouring plates.
- ◆ Sub culturing of bacteria by variety of solid-to-solid, solid-to-liquid, liquid-to-solid and liquid-to-liquid techniques.
- ◆ Serial dilution and enumeration of bacteria by plate count technique or turbidity measurements.
- ◆ Investigation of effect of temperature on growth or effect of pH or effect of oxygen (agar deeps) or utilisation of variety of carbohydrate sources (pH and gas production).
- ◆ Investigation of the effects of antibacterials on growth: antibiotics, disinfectants, antiseptics, skin care products, toothpaste/mouthwash.

Suitable practical activities for Outcome 2 are:

- ◆ Preparation of fixed smears of yeast, simple staining and examination by oil immersion microscopy to show budding.
- ◆ Preparation of wet mounts of mould/algae/protozoa.
- ◆ Preparation of hang drop preparations of protozoa/algae.
- ◆ Sub-culturing of moulds by stab and scalpel transfer.
- ◆ Serial dilution and enumeration of yeast by plate count technique or turbidity measurements.
- ◆ Growth of moulds on variety of agar types (purified/nutrient/malt extract).
- ◆ Investigation of the effects of antifungals on growth of yeasts and moulds: topical antifungals, essential oils, anti-dandruff shampoos.

Suitable practical activities for Outcome 3 are:

- ◆ Serial dilution, pour plates and enumeration of viruses by plaque assay.

Assessed practical experiments will usually be performed individually. However, there may be some experiments that are suitable to be undertaken in pairs or small groups. If this is the case then the assessor should ensure that all participants are actively involved and are able to adequately demonstrate the required skills.

Higher National Unit Support Notes (cont)

Unit title: Microbiology: Theory and Laboratory Skills (SCQF level 7)

An exemplar instrument of assessment with marking guidelines has been produced to indicate the national standard of achievement at SCQF level 7.

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.

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

The delivery and assessment of this Unit will provide learners with the opportunity to develop the Core Skills of *Numeracy* and Problem Solving at SCQF level 6, and *Information and Communication Technology (ICT)* at SCQF level 4.

Numeracy — Using Number at SCQF level 6

Learners will be required to decide on the steps and operations to solve complex problems, and carry out sustained and complex calculations, eg performing calculations related to serial dilutions and plate counts, utilising scientific notation.

Problem Solving — Reviewing and Evaluating at SCQF level 6

Following assessed practical experiments learners will be required to review and evaluate the effectiveness of the exercise with a thorough interpretation of random and systematic sources of error. Learners will be required to reach sound conclusions on the basis of the data collected and the inherent errors.

Information and Communication Technology (ICT) — Proving/Creating Information at SCQF level 4

Learners could make effective and appropriate use of ICT packages to produce laboratory reports or pro formas in an appropriate format. Packages used will likely include word processing, spreadsheets, and graph drawing software. They will also be required to utilise internet search engines to source information on research topics.

Higher National Unit Support Notes (cont)

Unit title: Microbiology: Theory and Laboratory Skills (SCQF level 7)

Sustainability

Sustainability can be embedded in delivery of the Unit in a variety of ways. For example minimising the use of disposable materials (such as plastic tips and paper towels) and chemicals (such as ethanol), as well as recycling where appropriate.

Employability Skills

Learners will be able to develop employability skills throughout delivery of the Unit. These range from developing aseptic technique to the ability to follow good laboratory practice and relevant health and safety guidelines.

Citizenship

Citizenship can be embedded in delivery of the Unit in a variety of ways. For example making informed decisions about diseases and their prevention as well as the application of microbes in biotechnology and genetic engineering. This will enable learners to make an effective contribution to discussions/debates on important matters that will influence not only their life but the lives of others.

History of changes to Unit

Version	Description of change	Date

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General information for learners

Unit title: Microbiology: Theory and Laboratory Skills (SCQF level 7)

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 is a 2 credit Unit at SCQF level 7, which you are likely to be studying as part of the first year of an HNC/HND Science programme. Before progressing to this Unit it would be beneficial to have completed the HN Unit H927 34 *Cell Biology: Theory and Laboratory Skills* where you will have learned underpinning aspects of cell structure and developed your practical skills.

On completion of the Unit you should be able to:

- 1 Describe and explain aspects of prokaryotic micro-organisms.
- 2 Describe and explain aspects of eukaryotic micro-organisms.
- 3 Describe and explain aspects of akaryotic micro-organisms.
- 4 Perform practical experiments related to microbiology.

Outcome 1

In this Outcome you will study prokaryotic microbes (those lacking a nucleus) and develop an understanding of their cell structure. You will examine how bacteria reproduce by the process of binary fission and what environmental conditions affect their growth and reproduction. Examples of such factors include temperature, pH, oxygen levels and availability of nutrients. This will enable you to understand the growth phases bacteria go through and what drives them from one phase to the next.

With an understanding of how bacteria grow and reproduce you will then investigate their occurrence in nature, looking at specific examples in habitats such as the human body, soil and water. You will look at how bacteria benefit man, whether naturally or by genetic engineering, as well as the problems they cause (eg disease).

Outcome 2

In this Outcome you will gain an understanding of eukaryotic microbes (those with a nucleus). You will learn about fungi (moulds and yeast) as well as algae and protozoa. You will examine how each of these groups reproduces by a variety of processes including spore production, budding and binary fission. You will investigate the effects of environmental conditions such as temperature, pH, oxygen levels and availability of nutrients on growth and reproduction.

With this knowledge you will then investigate their occurrence in nature, looking at specific examples in habitats such as the human body, soil and water. You will look at how these microbes benefit man, whether naturally or by genetic engineering, as well as the problems they cause (eg disease).

General information for learners (cont)

Unit title: Microbiology: Theory and Laboratory Skills (SCQF level 7)

Outcome 3

In this Outcome you will study viruses and sub-viral particles that are deemed as 'non-living'. You will look at their structure and the requirement for a host cell in which to grow and replicate. The lytic cycle of viral reproduction will be examined and suggested mechanisms of replication for sub-viral particles will also be covered.

With this knowledge you will then investigate their occurrence in nature, looking at specific examples in habitats such as the human body, soil and water. You will look at how viruses benefit man, whether naturally or by genetic engineering, as well as the problems they cause (eg disease).

Outcome 4

In this Outcome you will undertake practical experiments, the content of which will be related to Outcomes 1–3.

During this practical work, you will also be expected to develop good laboratory practices as well as improve your skills of manipulation, observation and measurement. You will also be encouraged to develop safe working practices and to strive constantly to improve the accuracy and reliability of your results. The reporting and analysis of experimental data is an important aspect of the practical sessions.

Assessment

For Outcomes 1 to 3 you will take a closed-book, end of Unit assessment.

Outcome 4 will be assessed after you have learned the necessary practical skills, and will take the form of two practical experiments, for which you will report your results either in full laboratory reports, or by completion of pro forma reports/laboratory books.

Core Skills

Although there is no automatic certification of Core Skills in the Unit, you will have opportunities to develop the Core Skills of *Numeracy* and *Problem Solving* at SCQF level 6, and *Information and Communication Technology (ICT)* at SCQF level 4.