

# Unit 35: Introduction to Microbiology for Health and Social Care

<b>Unit code:</b>	<b>D/600/8992</b>
<b>QCF Level 3:</b>	<b>BTEC Nationals</b>
<b>Credit value:</b>	<b>10</b>
<b>Guided learning hours:</b>	<b>60</b>

## ● Aim and purpose

This unit aims to enable learners to understand the role of micro-organisms in health and disease and the social benefits they provide.

## ● Unit introduction

Learners will initially explore the different types of micro-organisms, including those with pathogenic properties, consider requirements for their growth and reproduction, and methods by which they may be controlled. They will then consider the importance of micro-organisms in human health and disease, and the different ways in which the organisms may be transmitted from one individual to another. Learners will investigate the characteristics of organisms responsible for specific infectious diseases, including those that cause serious tropical illnesses.

The unit also investigates the ways in which micro-organisms are used for the benefit of humans, particularly in relation to the production of foods and pharmaceuticals, and also for the environment.

This unit will be useful for all learners, but especially for those who plan to work in the health or social care sectors.

## ● Learning outcomes

**On completion of this unit a learner should:**

- 1 Understand concepts of microbiology
- 2 Understand the role of micro-organisms in human health and disease
- 3 Understand the social benefits of micro-organisms.

# Unit content

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## 1 Understand concepts of microbiology

*Development of microbiology:* theory of spontaneous generation, miasma theory, germ theory; contributions of, eg Robert Hooke, Anton van Leeuwenhoek, Edward Jenner, Louis Pasteur, John Snow, Joseph Lister, Robert Koch; microscopic agents of communicable disease: pathogenic micro-organisms – viruses, bacteria, fungi, Protoctista, (eg Protozoa, unicellular green algae), prions; growth – requirements, rate, mechanism of reproduction

*Viruses:* structure, retroviruses, bacteriophages

*Bacteria:* prokaryotic, different types, eg cocci, bacilli, spirilli, vibrio; toxin formation, spore formation, plasmids, genetic exchange, pili, flagellae

*Fungi:* eukaryotic, yeasts, moulds

*Protozoa:* eukaryotic, different types, eg Plasmodium, Trypanosoma

*Methods of controlling micro-organisms:* policies and procedures for infection control; immunisation, eg against measles, mumps; chemical, eg disinfectants, antibiotics, antiseptics, salt, acids; temperature, eg refrigeration, freezing, use of autoclave; radiation, eg ultraviolet, gamma; vector control, eg mosquitoes, tsetse flies

## 2 Understand the role of micro-organisms in human health and disease

*Types:* endemic, epidemic, pandemic

*Transmission routes:* direct contact, fomites, directly into bloodstream, air-borne, food-borne, water-borne, vector-borne, transplacental

*'Normal flora':* symbiotic relationship, eg in gastrointestinal tract, respiratory tract, on skin

*Infection sources:* infective dose, infective site/route into body; the body as a reservoir of infection, eg large bowel, nose, skin, wounds; opportunist infections; carriers of infectious micro-organisms

*Viral infections:* types of, eg colds, influenza, measles, mumps, poliomyelitis, rubella, chickenpox, HIV/AIDS, hepatitis, herpes

*Bacterial infections:* types of, eg tuberculosis; salmonella food poisoning, staphylococcal food poisoning, streptococcal sore throat, whooping cough, meningococcal meningitis, bacterial dysentery, cholera

*Fungal infections:* yeasts, eg candidiasis; moulds, eg tineal infections

*Protozoan infections:* types of, eg malaria, sleeping sickness, trichomoniasis

*Prion infections:* Bovine Spongiform Encephalopathy (BSE), Creutzfeldt-Jakob Disease (CJD)

*Immune system:* the relationship between body systems, pathogens and immunity, eg the role of antibodies, immunoglobulins and leucocytes, eg macrophages and T-lymphocytes in protecting humans from pathogens; concept of 'herd immunity'

### 3 Understand the social benefits of micro-organisms

*Food:* products, eg bread, cheese/fermented milk products, wine, beer, vinegar, single-cell protein

*Pharmaceuticals:* production of antibiotics, vaccines, insulin

*Agriculture:* silage production, use in pesticides

*Recycling of matter:* role of bacteria and fungi in recycling of carbon and nitrogen through air and soil

*Genetic engineering:* use of micro-organisms to alter DNA codons

## Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
<b>P1</b> explain the role of scientists in the development of current understanding of microbiology [IE1; CT2; RL6]		
<b>P2</b> explain the characteristics of pathogenic micro-organisms [IE2]	<b>M1</b> explain the factors that influence the transmission of pathogenic micro-organisms to individuals and populations	<b>D1</b> analyse difficulties in controlling micro-organisms
<b>P3</b> explain the role of 'normal flora' in health and wellbeing [IE2]		
<b>P4</b> explain methods of controlling micro-organisms [IE2; TW1; TW5]	<b>M2</b> discuss the effectiveness of methods to control micro-organisms	<b>D2</b> evaluate the impact of infectious disease on the health and wellbeing of individuals and populations.
<b>P5</b> explain the principles of transmission of pathogenic micro-organisms [IE2]		
<b>P6</b> explain the social benefits of micro-organisms. [IE3; EP1; EP6]	<b>M3</b> discuss the ethical dilemmas that can arise from inappropriate use of micro-organisms.	

**PLTS:** This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills which are embedded in the assessment of this unit. By achieving the criteria, learners will have demonstrated effective application of the referenced elements of the skills.

<b>Key</b>	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

## Essential guidance for tutors

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### Delivery

This unit would benefit from being delivered by a tutor with specialist knowledge of microbiology. Small-group research and presentations could be useful means of introducing this unit, with learners investigating the contributions of various scientists to current understanding of microbiology. Some tutor input will be needed to introduce the microscopic agents of communicable disease, though this could be made more learner focused through worksheets, quizzes or practical activities.

If available, learners could use microscopes to examine fresh samples of micro-organisms, for example from a yeast suspension, yoghurt or blue cheese. Prepared slides of organisms could also be viewed. Images, for example of different virus particles, can be accessed through the internet. If appropriate facilities are accessible, simple experiments using yeast suspension or samples of dough can be used to explore the effect of temperature, salt and pH on controlling microbial activity.

The importance of micro-organisms in human health and disease could be delivered through a combination of tutor input, small-group research and presentations on specific diseases, or case studies and videos/DVDs. An overview of the basic physiology of the human immune system and its role in preventing disease, together with a discussion on how immunisation and vaccines prevent the spread of disease, is important to ensure a vocational context for the unit content.

Small group activities could also be used to share research into the benefits of micro-organisms, such as the production of different foods from micro-organisms or the production of antibiotics. A guest speaker from the local environmental health department could also be useful.

Further understanding relating to infection may be obtained from considering scenarios relating to learners' work experience placements, observing actual practices in settings, or from personal experiences.

Opportunities to discuss ethical issues relating to the use of genetic engineering, vaccines, and implications for health and social care of antibiotic resistance would be useful preparation for assessment.

## Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Unit introduction.
Tutor input: what is microbiology?
The development of microbiology; contributions of particular scientists.
Learner research/discussion: group research into the contributions of scientists and their theories to the current understanding of microbiology; present findings to group.
<b>Assignment 1: Microbiological theory (P1)</b>
Tutor input: microscopic agents (use of worksheets and practical activities where possible).
Practical activity: microscope work to view micro organisms from yeast, yoghurt or blue cheese for example, if resources allow; slides and internet images can also be used.
Tutor input: policies and procedures related to infection control when dealing with micro-organisms.
Practical experiment: to control micro-organisms – the effect of temperature, salt and pH for example.
Tutor input: introduction to the role of micro-organisms in human health and disease.
Tutor input: overview of human immune system; discussion about immunisation and vaccines.
Learner research: into particular diseases and how they affect the normal flora of a body; present findings to group.
<b>Assignment 2: Micro-organisms and human health (P2, P3, P4, P5, M1, M2, D1)</b>
Tutor input: other uses of micro-organisms, such as food products, pharmaceuticals, agriculture, recycling, genetic engineering etc.
Group work: investigate the benefits of micro-organisms, for example food production.
Guest speaker from industry: learners to prepare questions to help with their assignment preparation.
Discussion: about the ethical dilemmas that can arise from, for example, inappropriate use of antibiotics and using micro-organisms in genetic engineering.
Industry visit or work placement: observing practice related to microbiology.
Discussion: the implications of antibiotic resistance.
<b>Assignment 3: Social benefits of micro-organisms (P6, M3, D2)</b>
Unit review and assessment.

## Assessment

This unit could be assessed using three or four assignments. An initial assignment could be used fairly early in the delivery of the unit in order for learners to provide evidence for P1. This could be in the form of a written assignment or records from a presentation, such as a presentation and a witness statement. Evidence should show consideration of three different scientists from the unit content.

The second assignment could involve a case study of a person who has contracted an infection or disease for example salmonella or E-coli. This would provide the opportunity to assess P2 and P3 by showing the characteristics of the micro-organisms and their effects on the normal flora. Evidence for this will usually be written, possibly supplemented by annotated diagrams.

Learners are unlikely to be able to achieve D1 until they have gained an understanding of how micro-organisms are transmitted, and studied some specific examples. It is therefore suggested that the case study progresses to cover P4, P5, M1, M2 and D1. This would be a substantial piece of work and would need to be clearly divided into tasks. For P4, learners should have a clear understanding of three different ways of controlling micro-organisms, and be able to explain these for M1. D1 requires learners to consider difficulties in controlling micro-organisms, and will also require knowledge of the transmission of disease (P5, M2) in order for learners to be able to analyse these difficulties.

A final assignment could be used for P6, M3 and D2, involving a written piece of evidence in which learners explain four benefits of micro-organisms for P6. Learners could then discuss ethical dilemmas that can arise from the inappropriate use of antibiotics and as a consequence of the use of micro-organisms in genetic engineering for M3. This could include a report or a transcript of a class discussion, with a clear indication of the learner's own input – possibly evidenced through a witness statement or peer review.

For D2, the effect of infectious disease on individuals could relate, for example, to signs and symptoms whereas the effect on populations might involve looking at morbidity and mortality data, and consequences for communities such as the ability of their members to work.

## Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1	Microbiological theory	As part of your studies, it is important to consider how microbiological theory has developed. Take three scientists and research their theories.	Presentation/witness statement/notes or other written assignment.
P2, P3	Micro-organisms and human health	Whilst on placement at the local hospital a patient has contracted salmonella poisoning. As part of your placement you need to explain how this was contracted, and the effects this will have on the normal flora of the patient.	Case study review and annotated diagrams.
P4, P5, M1, M2, D1		Using the same case study, consider control and transmitting of micro-organisms and the difficulties associated with this.	
P6, M3, D2	Social benefits of micro-organisms	You have been asked to take part in a debate about the various uses of micro-organisms and the possible ethical issues associated with this.	Report or transcript from class debate/witness statement/review.

## Links to National Occupational Standards (NOS), other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Health and Social Care sector suite (see *Appendix A*) and has links with units from other qualifications in that suite. See *Appendix E* for NOS links and *Appendix G* for a mapping of the NHS Knowledge and Skills Framework against particular units in this qualification.

## Essential resources

The following resources are essential for delivery of this unit:

- an appropriately qualified tutor
- library resources with key texts and other reference materials.

In addition, audio and visual records are considered to be highly valuable.

## Employer engagement and vocational contexts

Delivery of this unit will be greatly enhanced by the inclusion of guest speakers and by relating discussion to work placements. Of particular interest are any links to the food, pharmaceutical, agriculture or genetic engineering industries.

## Indicative reading for learners

### Textbooks

Kent M – *Advanced Biology (Advanced Science)* (Oxford University Press, 2000) ISBN 9780199141951

Myers B – *The Natural Sciences* (Nelson Thornes, 2004) ISBN 9780748785834

Stretch B and Whitehouse M – *BTEC Level 3 Nationals in Health and Social Care Student Book 1* (Pearson, 2010) ISBN 9781846907663

Stretch B and Whitehouse M – *BTEC Level 3 Nationals in Health and Social Care Student Book 2* (Pearson, 2010) ISBN 9781846907470

Thomson H, Meggitt C, Aslangul S and O'Brien – *Further Studies for Health* (Hodder Arnold, 2002) ISBN 9780340804230

Toole A and S – *Understanding Biology for Advanced Level* (Nelson Thornes, 1999) ISBN 9780748739578

### Journals and magazines

*Biological Science*

*New Scientist*

*Nursing Times*

### Websites

[www.bbc.co.uk](http://www.bbc.co.uk)

BBC

[www.hpa.org.uk](http://www.hpa.org.uk)

Health Protection Agency

## Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
<b>Independent enquirers</b>	[IE 1] identifying questions to answer when researching scientific theory related to microbiology [IE2] planning and carrying out research related to a case study about the transmission and control of micro-organisms [IE3] considering issues and events from different perspectives when discussing the social benefits of micro-organisms
<b>Creative thinkers</b>	[CT2] asking questions to extend their thinking about scientific theory related to microbiology
<b>Reflective learners</b>	[RL6] communicating learning about the roles of scientists in the development of microbiology theory, in relevant ways
<b>Team workers</b>	[TW1,5] collaborating with others when carrying out practical work to control micro-organisms, taking responsibility to carry out tasks safely
<b>Effective participators</b>	[EP1,6] discussing issues of concern and at times acting as an advocate for beliefs that differ from their own when explaining the social benefits of micro-organisms.

## ● Functional Skills – Level 2

Skill	When learners are ...
<b>ICT – Use ICT systems</b>	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	selecting and using ICT systems to prepare assignments and presentations
<b>ICT – Find and select information</b>	
Select and use a variety of sources of information independently for a complex task	selecting and using a variety of sources of information on microbiological theory
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	searching for ICT-based information on microbiological theory using a variety of sources
<b>ICT – Develop, present and communicate information</b>	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> <li>• text and tables</li> <li>• images</li> <li>• numbers</li> <li>• records</li> </ul>	entering and developing information for presentations on microbiological theory and the benefits of micro-organisms for society
<b>English</b>	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	contributing to discussions about the social uses of micro-organisms and the possible ethical dilemmas related to these  making a presentation on the scientific theories of microbiology
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reading and synthesising information from a variety of texts related to the characteristics, transmission and control of micro-organisms, using the information to form opinions
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing different types of documents, clearly communicating information about microbiological theories and characteristics of micro-organisms.