

Cambridge TECHNICALS LEVEL 3

APPLIED SCIENCE

Unit 18 – Microbiology
DELIVERY GUIDE

Version 2

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INTRODUCTION

This Delivery Guide has been developed to provide practitioners with a variety of creative and practical ideas to support the delivery of this qualification. The Guide is a collection of lesson ideas with associated activities, which you may find helpful as you plan your lessons.

OCR has collaborated with current practitioners to ensure that the ideas put forward in this Delivery Guide are practical, realistic and dynamic. The Guide is structured by learning outcome so you can see how each activity helps you cover the requirements of this unit.

We appreciate that practitioners are knowledgeable in relation to what works for them and their learners. Therefore, the resources we have produced should not restrict or impact on practitioners' creativity to deliver excellent learning opportunities.

Whether you are an experienced practitioner or new to the sector, we hope you find something in this guide which will help you to deliver excellent learning opportunities.

If you have any feedback on this Delivery Guide or suggestions for other resources you would like OCR to develop, please email resources.feedback@ocr.org.uk.

OPPORTUNITIES FOR ENGLISH AND MATHS SKILLS DEVELOPMENT AND WORK EXPERIENCE

We believe that being able to make good progress in English and maths is essential to learners in both of these contexts and on a range of learning programmes. To help you enable your learners to progress in these subjects, we have signposted opportunities for English and maths skills practice within this resource. We've also identified any potential work experience opportunities within the activities. These suggestions are for guidance only. They are not designed to replace your own subject knowledge and expertise in deciding what is most appropriate for your learners.



English



Maths



Work

Please note

The activities suggested in this Delivery Guide **MUST NOT** be used for assessment purposes. The timings for the suggested activities in this Delivery Guide **DO NOT** relate to the Guided Learning Hours (GLHs) for each unit.

Assessment guidance can be found within the Unit document available from www.ocr.org.uk. The latest version of this Delivery Guide can be downloaded from the OCR website..

UNIT AIM

Microbiology is the study of microorganisms. Microorganisms affect every aspect of life on Earth. Some microorganisms cause disease but the vast majority are completely harmless.

The beneficial uses of microorganisms have been recognised and exploited for thousands of years in brewing, bread making and yogurt production. Bacteria occupy every habitat on Earth and form a biomass that exceeds that of all plants and animals. We now make use of bacterial ecology and metabolism in the production of natural fertilizers, pesticides and herbicides. Recent developments also include industrial applications such as cleaning up pollution and mining, and the production of important chemical and pharmaceutical products using genetically engineered microorganisms.

Microorganisms are also responsible for various diseases, however, which affect millions of people worldwide every year. As new antimicrobial therapies have been developed, microorganisms have developed resistance to them, and without the development of new drugs and other therapies, we face the possibility of unstoppable infectious diseases, as in the pre-antibiotic era.

In this unit you will learn about the commercial use of microorganisms in food production and in medical microbiology. You will also develop a range of practical manipulative skills, including aseptic technique and those used in bacterial identification, which will enable you to work safely and competently in a microbiology laboratory.

Unit 18 Microbiology

LO1	Be able to classify and identify microorganisms
LO2	Understand the use of microorganisms in agriculture
LO3	Be able to use microbiology in food production
LO4	Understand the action of antimicrobials on microorganisms

To find out more about this qualification, go to: <http://www.ocr.org.uk/qualifications/vocational-education-and-skills/cambridge-technicals-applied-science-level-3-certificate-extended-certificate-foundation-diploma-diploma-extended-diploma-05847-05849-05879-05874-2016-suite/>

**2016 Suite**

- New suite for first teaching September 2016
- Externally assessed content
- Eligible for Key Stage 5 performance points from 2018
- Designed to meet the DfE technical guidance

RELATED ACTIVITIES

The Suggested Activities in this Delivery Guide listed below have also been related to other Cambridge Technicals in Applied Science units/Learning Outcomes (LOs). This could help with delivery planning and enable learners to cover multiple parts of units.

This unit (Unit 18)	Title of suggested activity	Other units/LOs	
LO1	Groups of microorganisms Classification of bacteria Colony morphology and gram staining	Unit 1 Science fundamentals	LO3 Understand cell organisation and structures
	Aseptic techniques	Unit 2 Laboratory techniques	LO6 Be able to use aseptic technique
		Unit 8 Cell biology	LO2 Be able to use key cytological techniques
	Use of specialised growth media Serological and genetic methods	Unit 8 Cell biology	LO2 Be able to use key cytological techniques
LO2	Natural fermentation Biofertilizers, biopesticides and bioherbicides Energy production for agriculture	Unit 19 Crop production and soil science	LO2 Understand factors affecting the growth of crops
	Genetic engineering of crops Uses of genetic engineering of crops Evaluating the use of genetically engineered crops	Unit 5 Genetics	LO4 Understand the impact of an innovation in an application of genomics
LO3	Food industries that use microbiology Fermenters Optimum conditions for fermenters The chemical and physical nature of the products of fermenters	Unit 17 Food technology	LO1 Understand the main features of food manufacturing operations
	Biochemistry of fermentation Glycolysis	Unit 1 Science fundamentals	LO2 Understand reactions in chemical and biological systems
LO4	Types of antimicrobials Major classes of antibiotics Mode of action of antibiotics	Unit 1 Science fundamentals	LO3 Understand cell organisation and structures
	Antimicrobial resistance (AMR) Implications of AMR Solutions to AMR	Unit 6 Control of hazards in the laboratory	LO1 Understand the types of hazards that may be encountered in a laboratory

KEY TERMS

Explanations of the key terms used within this unit, in the context of this unit

Key term	Explanation
Antibiotic	A medicine that destroys or inhibits the growth of bacteria.
Antifungal	A medicine that destroys or inhibits the growth of yeasts and other fungi.
Antimicrobial	A medicine that destroys or inhibits the growth of microorganisms.
Antiviral	A medicine used to treat a disease caused by a virus.
Archaeans	Microorganisms that are similar to bacteria in size and structure, but have a different molecular organisation.
Aseptic	Free from contamination by microorganisms.
Bacilli	Rod-shaped bacteria.
Bacteria	Microscopic living organisms with a very simple structure.
Biofertilizer	A fertilizer that contains living organisms.
Bioherbicide	A herbicide that contains living organisms.
Biopesticide	A pesticide that contains living organisms.
Cocci	Spherical bacteria.
Fermentation	The chemical breakdown of a substance by microorganisms.
Genetic engineering	The deliberate modification of the characteristics of an organism by manipulating its genetic material.
Gram staining	A staining technique for the identification of bacteria.
Microorganism	A microscopic organism.
Spirilla	Spiral-shaped bacteria.
Vibrios	Curved rod-shaped bacteria.
Virus	A pathogen that is smaller than a bacterium and cannot grow or reproduce outside of a host.

MISCONCEPTIONS

Some common misconceptions and guidance on how they could be overcome		
What is the misconception?	How can this be overcome?	Resources which could help
All bacteria are harmful	Discuss that most bacteria are not harmful, and that we have non-harmful (often labelled 'good') bacteria living in our intestines and on our skin. Discuss that bacteria are useful to us, used to make food such as cheese and yoghurt, used in biotechnology to make medicines, such as human insulin.	You are your microbes TED-Ed https://www.youtube.com/watch?v=1X8p0vhsWRE An animation showing the bacteria that live on and in our bodies, and how they are useful to us.
Genetic engineering is always wrong	Discuss the benefits of genetically engineered plants that can withstand drought, and plants that have been genetically engineered to contain vitamins, to overcome vitamin deficiencies.	Drought resistant GM crops ready 'in four years' The Guardian https://www.theguardian.com/environment/2008/oct/07/gmcrops.food A news article discussing the development of drought-tolerant GM crops in the UK. Golden Rice Project http://www.goldenrice.org/index.php A website with information about how to make golden rice and why it is being produced.
Viruses can be treated with antibiotics	Explain that antibiotics can only be used to treat bacterial infections and will have no effect on a virus.	Antibiotics NHS Choices http://www.nhs.uk/Conditions/Antibiotics-penicillins/Pages/Introduction.aspx A web page explaining what antibiotics can and cannot be used for.
<i>E. coli</i> bacteria are always harmful	Explain that <i>E. coli</i> bacteria are mostly harmless and can be found living on our bodies. It is only a small percentage that cause illness.	Facts about <i>E. coli</i> NHS Choices http://www.nhs.uk/news/2009/09September/Pages/EcoliQA.aspx A web page explaining that <i>E. coli</i> is commonly found in our bodies and rarely causes illness.

SUGGESTED ACTIVITIES

LO No:	1		
LO Title:	Be able to classify and identify microorganisms		
Title of suggested activity	Suggested activities	Suggested timings	Also related to
Groups of microorganisms	<p>Introduce types of microorganisms with a video of the different types:</p> <p>Types of Microbes Mr Riddz Science https://www.youtube.com/watch?v=EsCe6qPz6tM Video on YouTube of different types of microorganisms.</p> <p>Learners could make a presentation to peers about viruses, archaea, bacteria and microscopic invertebrates, using these web pages for information:</p> <p>What is a Virus? Encyclopedia of Life http://eol.org/info/viruses</p> <p>What are Archaea? Encyclopedia of Life http://eol.org/info/457</p> <p>What are Bacteria? Encyclopedia of Life http://eol.org/info/bacteria</p> <p>Microscopic Invertebrates Rice University http://www.ruf.rice.edu/~bioslabs/studies/invertebrates/invertebrates.html</p>	2 hours	Unit 1 LO3
Classification of bacteria	<p>Discuss as a group the different shapes of bacteria: bacilli, cocci, spirilla and vibrios. Learners could look at some of the slides of the PowerPoint on classification of bacteria:</p> <p>Classification of Bacteria NHS Biology https://nhsbiology.wikispaces.com/file/view/Classification+of+Bacteria.ppt</p> <p>Learners could look at slides of bacteria using a microscope and identify some different bacteria by their shape.</p>	1 hour	Unit 1 LO3

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Aseptic techniques 	<p>Learners could grow some bacteria on agar plates using aseptic techniques. Here is a method that could be used:</p> <p>Practical Biology: Aseptic techniques Nuffield Foundation http://www.nuffieldfoundation.org/practical-biology/aseptic-techniques This web page could be used by tutors and learners to set up an investigation using aseptic techniques.</p>	1 hour	Unit 2 LO6 Unit 8 LO2
Colony morphology and gram staining 	<p>Tutors could introduce the session with this video:</p> <p>Classification of Bacteria (Antibiotics – Lecture 1) Strong Medicine https://www.youtube.com/watch?v=OOGGM6mxjY0 This video discusses using gram staining to identify bacteria, and other methods of identification.</p> <p>The group could also discuss colony morphology using this web page:</p> <p>Observing bacteria in a petri dish Microbiology Society http://www.microbiologyonline.org.uk/teachers/observing-microbes/observing-bacteria-in-a-petri-dish</p> <p>Learners could observe the agar plates they made using aseptic techniques and characterise the colony morphology. They could also research the bacteria that they grew on the plates and decide whether or not they would stain with gram staining.</p>	1 hour	Unit 1 LO3
Use of specialised growth media 	<p>Learners could research the use of specialised growth media, e.g. MacConkey's agar, Mannitol salt agar (MSA), or differential media, e.g. blood agar, to identify microorganisms.</p> <p>A good source of information is:</p> <p>Selective and Differential Media for Identifying Microorganisms Virtual Amrita Laboratories Universalizing Education (VALUE) http://vlab.amrita.edu/?sub=3&brch=73&sim=720&cnt=1 This web page discusses how to use selective and differential media.</p> <p>Learners could write methods for using a specialised growth medium and a differential medium to identify microorganisms.</p>	1 hour	Unit 8 LO2

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Serological and genetic methods	<p>Learners could research one way to use a serological (using antibodies) or genetic technique to identify microorganisms, and present their findings to peers.</p> <p>A good source of information is:</p> <p>Methods Of Identifying And Classifying Microorganisms Midlands Technical College http://classes.midlandstech.edu/carterp/Courses/bio225/chap10/lecture3.htm</p> <p>This web page gives an overview on different serological, genetic and other techniques for identifying microorganisms.</p>	1 hour	Unit 8 LO2



SUGGESTED ACTIVITIES

LO No:	2		
LO Title:	Understand the use of microorganisms in agriculture		
Title of suggested activity	Suggested activities	Suggested timings	Also related to
Natural fermentation	<p>Watch video on making silage as an introduction. Silage is a type of natural fermentation.</p> <p>How to Succeed in Making Quality Silage? Valacta https://www.youtube.com/watch?v=hUug_KF6vQo This is a five-minute video on how to make silage.</p> <p>Learners could then look at some information on how bacteria are used in the silage making process and make some silage of their own. A good website for this is:</p> <p>Making your own silage The University of Waikato http://biotechlearn.org.nz/themes/future_farming/making_your_own_silage Sets out how students can make silage at school.</p> <p>Paper 2.0: Silage fermentation processes and their manipulation Stefanie J.W.H. Oude Elferink, Frank Driehuis, Jan C. Gottschal, and Sierk F. Spoelstra http://www.fao.org/docrep/005/x8486e/x8486e09.htm#bm9 This paper reviews current knowledge on general silage microbiology with the aim of assisting in the choice of the best ensiling strategy to produce high quality silage.</p> <p>A good source of information about bacteria in silage is:</p> <p>Understanding Silage Fermentation: Background Information Penn State University www.forages.psu.edu/topics/hay_silage/preservation/silage_preserv/#Respiration A web page with some animations about the bacteria involved in silage.</p>	1 hour	Unit 19 LO2

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Biofertilizers, biopesticides and bioherbicides	<p>Biofertilizers are substances that contain living organisms and increase the supply of primary nutrients to plants or seeds.</p> <p>Tutors could discuss the use of leguminous plants in agriculture, and the <i>Rhizobium</i> bacteria that live in their nodules.</p> <p>The Legume-Root Nodule Symbiosis Boundless https://www.boundless.com/microbiology/textbooks/boundless-microbiology-textbook/microbial-ecology-16/microbial-symbioses-196/the-legume-root-nodule-symbiosis-993-7114/ This web page gives information about <i>Rhizobium</i>.</p> <p>Biopesticides are a form of pest control that contains living organisms. For example, bacteria are used to control plant diseases. History of Biopesticides Biopesticide Industry Alliance http://www.bpia.org/history-of-biopesticides/ This web page tells the history of biopesticides and gives some examples.</p> <p>Bioherbicides are substances that contain living organisms and control weeds. For example the fungus <i>Phytophthora palmivora</i> does not allow the milkweed vine to grow.</p> <p>Bioherbicides Zvonko Pacanoski http://www.intechopen.com/books/herbicides-physiology-of-action-and-safety/bioherbicides This web page gives detailed information about the history, use and limitations of bioherbicides.</p> <p>Learners could visit an organic farm or listen to a guest speaker talk about organic farming.</p> <p>Soil Association https://www.soilassociation.org/ The Soil Association has lots of useful information about organic farming and its benefits to people and wildlife.</p>	1 hour	Unit 19 LO2

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Energy production for agriculture	<p>Anaerobic digestion (AD) is the breakdown of organic material by microorganisms in the absence of oxygen, and can produce biogas. Biogas contains methane and can be used as a fuel. Using waste material to make fuel is a type of renewable energy.</p> <p>Tutors could use this video as an introduction:</p> <p>How Does a Biogas Plant Work? Weltec Biopower https://www.youtube.com/watch?v=xy1EIXIS1JQ A six-minute video.</p> <p>More information can also be found at:</p> <p>What is AD? The Anaerobic Digestion & Bioresources Association http://adbioresources.org/about-ad/what-is-ad This web page gives details about the process of AD.</p> <p>Learners could produce a guidance booklet for farmers on the benefits of using biofuels.</p>	1 hour	Unit 19 LO2
Genetic engineering of crops	<p>Introduce this topic with this video:</p> <p>How Are GMOs Created? GMO Answers https://www.youtube.com/watch?v=2G-yUuiqIz0 This video discusses in detail how rainbow papaya was genetically modified to resist a virus.</p> <p>Learners could research and make a presentation for their peers showing one method of how a plant is genetically modified. More information about using bacteria to genetically modify plants can be found at:</p> <p>The Microbial World: Biology and Control of Crown Gall (<i>Agrobacterium tumefaciens</i>) Jim Deacon, with assistance of Aline Robertson and Alan Isbister Institute of Cell and Molecular Biology, The University of Edinburgh http://archive.bio.ed.ac.uk/jdeacon/microbes/crown.htm This web page discusses in detail how <i>Agrobacterium tumefaciens</i> and its plasmids can be used to introduce new genes to plants.</p>	1 hour	Unit 5 LO4



Title of suggested activity	Suggested activities	Suggested timings	Also related to
<p>Uses of genetic engineering of crops</p> 	<p>GM crops are used in human and animal food. Learners could research the characteristics developed in GM crops, including:</p> <ul style="list-style-type: none"> • nutritional characteristics • pest resistance, using the <i>Bacillus thuringiensis</i> gene • herbicide resistance. <p>They could produce an information leaflet for farmers on the advantages and disadvantages of using GM crops. Resources for this include:</p> <p>The case of the FLAVR SAVR tomato California Agriculture http://calag.ucanr.edu/Archive/?article=ca.v054n04p6 The FLAVR SAVR tomato was the first genetically engineered crop product to be commercialised.</p> <p>Pest resistant crops GeneWatch http://www.genewatch.org/sub-568238 Web page discussing pest resistance using the <i>Bacillus thuringiensis</i> gene.</p> <p>Herbicide tolerant crops GeneWatch http://www.genewatch.org/sub-568237 Web page that describes the development of GM herbicide resistant plants.</p>	1 hour	Unit 5 LO4
<p>Evaluating the use of genetically engineered crops</p>	<p>Groups could debate the advantages and disadvantages of using GM crops, including ethical, social and environmental concerns. They could then produce a SWOT analysis on GM crops (strengths/weaknesses/opportunities/threats).</p> <p>Information can be found at:</p> <p>10 Advantages and Disadvantages of GMOs FutureofWorking http://futureofworking.com/10-advantages-and-disadvantages-of-gmos/ Lists five advantages and five disadvantages.</p> <p>Genetically Modified Organisms (GMO's) Nutrition Care Systems http://www.nutritioncaresystems.com/genetically-modified-organisms-gmos/ Presents some pros and cons of GMOs.</p>	30 minutes	Unit 5 LO4

SUGGESTED ACTIVITIES

LO No:	3		
LO Title:	Be able to use microbiology in food production		
Title of suggested activity	Suggested activities	Suggested timings	Also related to
Food industries that use microbiology	<p>Class could discuss food that is made using microorganisms, e.g. cheese, wine, and make a list. Some useful videos are:</p> <p>How It's Made - Blue Stilton Cheese Discovery and Science Channel https://www.youtube.com/watch?v=unVdU4MgRAA</p> <p>How It's Made Wine Discovery Channel https://www.youtube.com/watch?v=w2_w_JvRi5g</p>	30 minutes	Unit 17 LO1
Biochemistry of fermentation	<p>Fermentation of organic substrates, e.g. grapes, takes place in the absence of oxygen. Yeast breaks down sugars into ethanol and carbon dioxide. In order to make wine, nitrogen must also be present.</p> <p>Learners could research the fermentation of wine and the importance of sugars (carbon source) and nitrogen in that process, and carry out fermentation of glucose using yeast. This is a good web page to use to plan this activity:</p> <p>Fermentation of glucose using yeast Nuffield Foundation and the Royal Society of Chemistry http://www.rsc.org/learn-chemistry/resource/res00000470/fermentation-of-glucose-using-yeast?cmpid=CMP00005115</p> <p>Some useful resources are:</p> <p>The Fermentation of Fructose in Winemaking Lallemand http://www.scottlab.com/uploads/documents/The%20Fermentation%20of%20Fructose%20in%20Winemaking.pdf Describes the process of winemaking in detail.</p> <p>Nitrogen Metabolism During Fermentation Dr Murli Dharmadhikari https://www.extension.iastate.edu/wine/sites/www.extension.iastate.edu/files/wine/NitrogenMetabolismDuringFermentation.pdf Explains the role of nitrogen in winemaking.</p>	1 hour	Unit 1 LO2

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Glycolysis	<p>Glycolysis is the breakdown of sugars into pyruvate. It is the first stage of aerobic and anaerobic respiration. Pyruvate is converted into alcohol by enzymes.</p> <p>A useful introductory video is:</p> <p>Animation: How Glycolysis Works Seeley, R., Stephens, T. and Tate, P. <i>Anatomy and Physiology</i>, McGraw-Hill http://highered.mheducation.com/sites/0072507470/student_view0/chapter25/animation_how_glycolysis_works.html Animation describing glycolysis.</p> <p>Learners could carry out fermentation of sauerkraut in anaerobic conditions to show how the sugars in sauerkraut are converted to acids and then into ethanol.</p>	1 hour	Unit 1 LO2
Fermenters	<p>Tutors could show the learners a diagram of a fermenter and they could label it as a class. The tutor could explain the role of each part of the fermenter.</p> <p>5.8 interpret and label a diagram of an industrial fermenter Chris Biology http://chrisbiology.blogspot.co.uk/2012/02/58-interpret-and-label-diagram-of.html Web page with a choice of two fermenter diagrams.</p> <p>Some information about fermenters:</p> <p>Fermentor Open Source Ecology http://opensourceecology.org/wiki/Fermentor Web page about fermenters.</p>	30 minutes	Unit 17 LO1

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Optimum conditions for fermenters	<p>Learners could research the optimum conditions needed in a fermenter and add this information to the fermenter diagram. Conditions should include:</p> <ul style="list-style-type: none"> • hygiene • nutrients • pH • oxygen concentration • duration of fermentation • separation of product, if required. <p>Some useful information can be found here:</p> <p>Chapter 3: Yeast Fermentations Fermented Fruits and Vegetables: A Global Perspective FAO Agricultural Service Bulletin No. 134 http://www.fao.org/docrep/x0560e/x0560e08.htm Web page about the optimum conditions in fermenters.</p>	30 minutes	Unit 17 LO1
The chemical and physical nature of the products of fermenters	<p>Class could discuss the type of products that could be made by fermenters and make a fermenter in the lab to produce a simple bacterial culture.</p> <p>Some good resources are:</p> <p>Wine, Beer, And Alcohol Boundless https://www.boundless.com/microbiology/textbooks/boundless-microbiology-textbook/industrial-microbiology-17/the-microbiology-of-food-201/wine-beer-and-alcohol-1008-11101/ A web page discussing the fermentation of beer, wine and spirits.</p> <p>How Beer Works HowStuffWorks http://science.howstuffworks.com/innovation/edible-innovations/beer4.htm A web page about beer fermentation.</p>	30 minutes	Unit 17 LO1

SUGGESTED ACTIVITIES

LO No:	4		
LO Title:	Understand the action of antimicrobials on microorganisms		
Title of suggested activity	Suggested activities	Suggested timings	Also related to
Types of antimicrobials	<p>Learners could research one of the main types of antimicrobial drugs, e.g. antibiotics, antifungals, and present their findings to the rest of the group. More information can be found at:</p> <p>Antibiotics: How Do Antibiotics Work? MediLexicon International http://www.medicalnewstoday.com/articles/10278.php Web page detailing what antibiotics are.</p> <p>Antifungal Medicines Patient http://patient.info/health/antifungal-medicines Web page about the use of antifungals.</p> <p>Antiviral Drugs Paul Nicholls http://www.pfnicholls.com/science/drugs/Antiviral%20Drugs.html Web page on how antiviral drugs work.</p>	30 minutes	Unit 1 LO3
Major classes of antibiotics	<p>Tutors could teach the group about the different types of antibacterial drug and the learners could make a poster about all of the different types. A good resource to use is:</p> <p>Antibiotics Guide Drugs.com https://www.drugs.com/article/antibiotics.html A web page on the different classes of antibiotic.</p>	30 minutes	Unit 1 LO3
Mode of action of antibiotics	<p>Each type of antibiotic has a different mechanism of action. Learners could research each mechanism and add to their poster on the different types of antibiotic. A good resource is:</p> <p>Mode of Action Antimicrobial Resistance Learning Site, Michigan State University http://amrls.cvm.msu.edu/pharmacology/antimicrobials/mode-of-action Web page about the mode of action of different antibiotics.</p>	1 hour	Unit 1 LO3

Title of suggested activity	Suggested activities	Suggested timings	Also related to
Antimicrobial resistance (AMR)	<p>Tutors could discuss the rise of antimicrobial resistance with the group. A good introductory video is:</p> <p>The Animation of Antimicrobial Resistance MediCanon https://www.youtube.com/watch?v=AYvX8tnCM9s A video showing animations of the different ways in which resistance can develop.</p>	30 minutes	Unit 6 LO1
Implications of AMR	<p>The group could discuss the implications of AMR and what would happen if we could no longer use antimicrobials.</p> <p>Some good resources are:</p> <p>Antibiotic resistance: causes, consequences and means to limit it Greenfacts http://www.greenfacts.org/en/antimicrobial-resistance/ Web page about antibiotic resistance.</p> <p>The Impact of Antimicrobial Resistance on Health and Economic Outcomes Clinical Infectious Diseases http://cid.oxfordjournals.org/content/36/11/1433.full Document about the impact of AMR on health.</p>	1 hour	Unit 6 LO1
Solutions to AMR	<p>The tutor could introduce the group to some alternatives to using AMR, e.g. medical maggots, slat baths, and the group could have a discussion about this.</p> <p>A guest speaker (doctor or scientist) could talk to the group about AMR.</p> <p>Resources for this can be found at:</p> <p>Antibiotic alternatives rev up bacterial arms race Nature http://www.nature.com/news/antibiotic-alternatives-rev-up-bacterial-arms-race-1.17621 Web page outlining alternatives to antimicrobial drugs.</p> <p>A review of the evidence for the use of topical antimicrobial agents in wound care World Wide Wounds http://www.worldwidewounds.com/2004/february/Cooper/Topical-Antimicrobial-Agents.html Web page looking at the effectiveness of antimicrobial drug alternatives.</p>	1 hour	Unit 6 LO1



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Cambridge Technicals Level 3

Applied Science

textbook

Developed in partnership with Hodder Education this book covers a range of units within this qualification. <http://www.hoddereducation.co.uk/Product/9781471874826.aspx>

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