

SQA Advanced Unit specification

General information

Unit title: Industrial Biotechnology: Processing (SCQF level 7)

Unit code: HV05 47

Superclass: RH

Publication date: November 2017

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This Unit is designed to enable learners to understand key aspects of industrial biotechnology processing including bioreactor types and their applications in a range of industries, which can include beverage, chemicals, pharmaceuticals and industrial biotechnology. The Unit is suitable for learners studying at SQA Advanced Certificate/SQA Advanced Diploma level, and will provide the necessary underpinning knowledge and skills to enable progression to further study of fundamental chemistry at SQA Advanced Diploma level or to seek employment in science and engineering based industries.

Outcomes

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

- 1 Describe the principles of industrial biotechnology.
- 2 Describe bioreactor types used in industrial biotechnology processing.
- 3 Describe industrial biotechnology applications.
- 4 Describe the process involved in the production of a selected industrial biotechnology application.

Credit points and level

1 SQA Credit at SCQF level 7: (8 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 prior experience of Biology and Chemistry at SCQF level 6.

SQA Advanced Unit Specification

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.

SQA Advanced Unit specification: Statement of standards

Unit title: Industrial Biotechnology: Processing (SCQF level 7)

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.

Outcome 1

Describe the principles of industrial biotechnology.

Knowledge and/or Skills

- ◆ Aseptic technique and sterilisation
- ◆ Upstream processing
- ◆ Downstream processing

Outcome 2

Describe bioreactor types used in industrial biotechnology processing.

Knowledge and/or Skills

- ◆ Fermenters
- ◆ Photobioreactors
- ◆ Open Ponds
- ◆ Hybrid systems

Outcome 3

Describe industrial biotechnology applications.

Knowledge and/or Skills

- ◆ Chemical Industries
- ◆ Bioenergy
- ◆ Food and agriculture

Outcome 4

Describe the process involved in the production of a selected industrial biotechnology application.

Knowledge and/or Skills

- ◆ Manufacturing process
- ◆ Health and safety implications
- ◆ Commercial value of the product

SQA Advanced Unit Specification

Evidence Requirements for this Unit

Written and/or oral recorded evidence for Outcomes 1–3 should be assessed using a single holistic closed-book assessment under supervised conditions. It is recommended that the assessment be completed within 60 minutes. Outcome 4 should be assessed by either a short written report or an oral presentation.

Learners will need to provide evidence to demonstrate their Knowledge and/or Skills across all Outcomes.

Outcome 1

The assessment will cover all of the Knowledge and/or Skills items.

A learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ describe the use of aseptic technique and sterilisation in an industrial biotechnology setting.
- ◆ describe the key components related to upstream processing in an industrial biotechnology setting.
- ◆ describe the key components related to downstream processing in an industrial biotechnology setting.

Outcome 2

The assessment will cover all of the Knowledge and/or Skills items.

A learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ describe the main types of bioreactor used for fermentation in the industrial biotechnology sector.
- ◆ describe the main types of photo-bioreactors used in the industrial biotechnology sector.
- ◆ describe the open pond reactors used in the industrial biotechnology sector.
- ◆ describe the main types of hybrid bioreactor systems used in the industrial biotechnology sector.

Outcome 3

The assessment will cover all of the Knowledge and/or Skills items.

A learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ describe two chemicals produced using industrial biotechnology methods.
- ◆ describe the production of a biofuel using an industrial biotechnology method.
- ◆ describe how industrial biotechnology is used in the production of a food product or agriculture product.

SQA Advanced Unit Specification

Outcome 4

The assessment will cover all of the Knowledge and/or Skills items.

A learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ describe, briefly the process to manufacture product using industrial biotechnology methods.
- ◆ describe health and safety implications of the chosen product.
- ◆ describe the commercial value and potential development of the chosen product.

SQA Advanced Unit Support Notes

Unit title: Industrial Biotechnology: Processing (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 40 hours.

Guidance on the content and context for this Unit

This Unit may form part of a group award or be completed as a free-standing Unit. It is designed to enable learners to understand key aspects of industrial biotechnology processing and its applications in a range of industries.

These Outcomes are intended to give a broad overview of bioindustrial processes.

Describe the process involved in the production of a selected industrial biotechnology application.

Outcome 1

Different aseptic techniques and sterilization processes should be explained. Growth parameters and kinetics including: temperature, agitation, pH, air, CO₂ and light availability should be described, as well as analytical procedures of microbial growth for both batch and continuous cultures.

Media and cultures preparations, selection of microorganisms and cell isolation, in addition harvesting should be covered.

Outcome 2

Different types of fermenters should be explained. Stirred tank, flat panel, helical type and oscillatory baffled bioreactors should be covered. Horizontal and vertical tubular photobioreactors including both bubble and airlift columns should be discussed. Open ponds and hybrid systems should be explained.

Outcome 3

Pharmaceutical bioproducts including antibiotic, cytotoxic, immunosuppressive products should be described. Agricultural applications including increasing productivity and bio-fertilizers should be covered. Renewable energy resources and bioenergy generation including bio-hydrogen, bio-methane and bio-diesel should be explained. Environmental applications including wastewater and effluents treatment using microorganisms should be discussed. Food industries including proteins and vitamins should be described.

Outcome 4

It is recommended the candidates choose their own topic for this Outcome, an area of particular interest or relevance to them. The work should show a good understanding of the biochemistry involved in the manufacture of their chosen product, as well as the commercial production of the material. The environmental and health and safety implications should be addressed in some details, demonstrating an understanding of the wider implications of the bioprocesses involved. Finally, the candidate should have a clear view of their chosen biochemical production route, ideally within a relevant marketplace either locally or internationally.

SQA Advanced Unit Specification

Guidance on approaches to delivery of this Unit

It is envisaged that the content of this Unit could be delivered standalone, or embedded within other Units of the SQA Advanced award. Centres may choose to integrate selected Outcomes within other Units.

It is envisaged that the delivery of Outcome 1 would commence with the definition of biomass and the different methods of measurement: chemical, physical and microscopic.

The different media categories should be covered after explaining sources of carbon, nitrogen, phosphate and other inorganic anions.

Sterilization processes should be discussed in some details including the different approaches of sterilisation: moist heat, dry heat, filtration and chemical means, as well as the sterilization of gases.

Industrial biotechnology process control should be covered which might include: pH measurement and control agents, dissolved oxygen, temperature measurement and control, foam detection and control, dissolved CO₂, agitation and level control.

Outcome 2 should commence with advantages and disadvantages of fed-batch and continuous processes.

The characteristics and main advantages and disadvantages of the following different types of system used in industrial biotechnology should be explained:

- ◆ Open pond systems with different shapes and sizes
- ◆ Stirred tank bioreactor
- ◆ Oscillatory baffled bioreactor
- ◆ Horizontal tubular bioreactor
- ◆ Vertical tubular bioreactor:
 - Bubble photobioreactor
 - Airlift photobioreactor
- ◆ Flat paned bioreactor
- ◆ Helical type bioreactor
- ◆ Hybrid systems

Outcome 3 could commence with application of biotechnology in the health and food industry as important sources for valuable chemicals: fatty acids, minerals, pigments, proteins, vitamins and amino acids, antiviral polysaccharides, toxic-adsorbants minerals.

The application in the pharmaceutical industries maybe covered explaining the importance of some secondary metabolites cytotoxic, immunosuppressive and enzyme inhibiting activities. Also agricultural and environmental application should be covered including; increasing productivities of crops, the ability of some microorganisms to gradually transform a barren soil into a fertile one; the removal of phosphorous and nitrate from ground water, and CO₂ bioremediation.

The importance of industrial biotechnology applications in renewable energy resources should be covered including bio-hydrogen, bio-ethanol, bio-methane, and biodiesel.

In Outcome 4 the learner should briefly describe the process to manufacture product using industrial biotechnology methods. The health and safety implications of the chosen product

SQA Advanced Unit Specification

should be discussed. As well as the commercial value and potential development of the chosen product should be explained.

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.

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.

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 question and answer style assessment with an appropriate cut-off score. Assessment should be carried out in supervised conditions, it is recommended that the assessment be completed within 60 minutes.

Outcome 4 should be assessed using an essay or a presentation. In Outcome 4 learners are required to produce a short written essay (approximately 800–1,000 words) or give an oral presentation. Both the report and presentation should cover the required knowledge and skills. If an oral presentation is chosen then an assessor's checklist and /or video recording could be used to gather evidence.

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 assessments methods, this helps them to develop different skills that should be transferrable 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

There is no automatic certification of Core Skills or Core Skill components in this Unit.

There will be opportunities to develop Core Skills throughout this Unit, examples of which are as follows:

Numeracy — Using Number and Using Graphical Information 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 throughout the Unit, along with using graphical data to solve problems, in particular in Outcome 1.

Problem Solving — Critical Thinking at SCQF level 6

Learners will develop their critical thinking skills by solving problems, comparing processes and selecting formula.

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

Candidates will make effective and appropriate use of ICT packages to produce reports or oral presentation in an appropriate format. Packages used will likely include word processing, PowerPoint, and specialist chemical structure software.

Communication: Written and/or Oral at SCQF level 6

Candidates will develop written and/or oral presentation skills in the delivery of Outcome 4. This will include reading materials and presenting them in a coherent and understandable structure to a target audience.

History of changes to Unit

Version	Description of change	Date

© Scottish Qualifications Authority 2015, 2017

This publication may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our [Centre Feedback Form](#).

General information for learners

Unit title: Industrial Biotechnology: Processing (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 1 credit Unit at SCQF level 7, which may be studied as part of your first or second year of an SQA Advanced Certificate/Diploma programme or as a freestanding unit. Before progressing to this Unit it would be beneficial to have completed study Mathematics at SCQF level 6 (Higher level) where you will have learned underpinning aspects of chemistry and developed your mathematical skills. There is a strong emphasis in the Unit on the applications of the physical chemistry taught and in particular industrial applications.

On completion of the Unit you should be able to:

- 1 Describe the principles of industrial biotechnology.
- 2 Describe bioreactor types used in industrial biotechnology processing.
- 3 Describe industrial biotechnology applications.
- 4 Describe the process involved in the production of a selected industrial biotechnology application.

Outcome 1

In Outcome 1 you will learn about different aseptic techniques and sterilization procedures. You will study growth conditions including: temperature, agitation, pH, air, dissolved CO₂, as well as analytical procedures of microbial growth for both batch and continuous cultures. Media and cultures preparations, selection of microorganisms and cell isolation, in addition harvesting will be explained.

Outcome 2

In Outcome 2 you will learn about different types of fermenters, stirred tank, flat panel, helical type and oscillatory baffled bioreactors. Horizontal and vertical tubular photobioreactors including both bubble and airlift columns will be discussed as well as open ponds and hybrid systems should be explained.

Outcome 3

In Outcome 3 you learn about different applications of industrial biotechnology. Pharmaceutical application including antibiotic, cytotoxic, immunosuppressive products will be described. Agricultural applications with increasing productivity of crops and bio-fertilizers will be covered. Renewable energy resources and bioenergy generation including bio-hydrogen, bio-methane and bio-diesel will be explained. Environmental applications including wastewater and effluents treatment using microorganisms will be discussed. Food industries including proteins and vitamins will be described.

Outcome 4

In Outcome 4 you will choose an industrial biotechnology process of a particular interest to you and write an essay of approximately 800–1,000 words or give a presentation. You will briefly describe the process to manufacture product using industrial biotechnology methods,

SQA Advanced Unit Specification

explain health and safety implications of the chosen product, as well as describe the commercial value and potential development of the chosen product.

Assessment

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

In Outcome 4, you will write a report or deliver a presentation on an industrial biotechnology process of your interest.

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* at SCQF level 6, *Problem Solving* at SCQF level 6, *Information and Communication Technology (ICT)* at SCQF level 4 and *Communication: Written and/or Oral* at SCQF level 6.