Higher National Unit Specification

General information

Unit title: Science for the Food Industry: An Introduction (SCQF level 6)

Unit code: F6VB 33

Superclass: NH

Publication date: June 2019

Source: Scottish Qualifications Authority

Version: 03

Unit purpose

The purpose of this unit is to provide learners with the theoretical and practical scientific knowledge and understanding that underpins the science within food technology. Learners will develop practical skills relevant to cellular biology and chemistry at SCQF level 6 and will provide the necessary underpinning knowledge and skills to enable progression to further study of Food Science and Technology or seek employment within the Food Science/Technology sectors.

Outcomes

On completion of the unit the learner should be able to:

1 Explain the cellular nature of food.
2 Explain basic scientific concepts applicable to food technology.
3 Perform basic laboratory techniques.

Credit points and level

1 Higher National Unit credit at SCQF level 6: (8 SCQF credit points at SCQF level 6)

Recommended entry to the unit

Entry to this unit will be at the discretion of the centre. This unit is suitable for learners with no prior knowledge of science. However, it is recommended that learners have either studied Biology or Chemistry at SCQF level 5 or have work experience within the food science/technology sectors.

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.

This unit is part of the PDA in Food Science. It is intended for learners who have not previously completed units in a scientific subject at SCQF level 6. It will prepare learners for the units *Food Analysis, Food Composition and Microbiology of Foods 1*, all of which are units on the PDA in Food Science.

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

Explain the cellular nature of food.

Knowledge and/or skills

- Plant and animal cells
- Cell structure in relation to function
- Respiration, photosynthesis and osmosis

Outcome 2

Explain basic scientific concepts applicable to food technology.

Knowledge and/or skills

- Structure of molecules and compounds
- Properties of compounds
- Carbon compounds
- Functional groups and homologous series
- Solutions and colloidal suspensions
- Acidity and alkalinity
- Heat

Outcome 3

Perform basic laboratory techniques.

Knowledge and/or skills

- Follow instructions for an experiment
- Safe working practices in a laboratory
- Precise results
- Reporting of results

Higher National Unit Specification: Statement of standards (cont)

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Evidence requirements for this unit

Learners will need to provide evidence to demonstrate their knowledge and/or skills across all outcomes by showing that they can:

Outcome 1

- explain the cell structure of a plant and animal cell: the explanation should cover the function of nucleus, cytoplasm, chloroplast, cell membrane and cell wall and should include a correctly labelled diagram of each cell.
- explain respiration, photosynthesis and osmosis: the explanation should outline what each involves and should include an illustrative example related to the food industry.

Outcome 2

- explain one structure of a molecule and one structure of a compound: the explanation should refer to different types of bonding and to the Periodic Table.
- explain one property of a compound: the property should be selected from melting point, boiling point and hardness/softness.
- explain two carbon compounds: the compounds should be selected from alkanes, alkenes, alkanols, alkanals, alkanones, alkanoic acids or alkyl alkanoates (esters).
- explain one functional group: the functional group should be selected from hydroxyl, carbonyl, carboxyl and amino.
- explain one solution and one colloidal suspension: the colloidal suspension should be chosen from sols, gels or emulsions.
- explain acidity and alkalinity with reference to the pH scale.
- explain heat by giving one example of a change of state and one example of heat transfer: the example of change of state should be taken from latent heat, boiling and melting point or specific heat capacity and the example of heat transfer should be taken from conduction, convection or radiation.

In each case, the explanation should refer to a relevant example related to food technology. Explanations should be scientifically accurate and, where appropriate, should make use of relevant formulae.

Outcome 3

Learners will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can perform two laboratory experiments accurately and record the results in a suitable format. Records should include:

- all relevant results, including correct calculations where appropriate
- a summary of conclusions drawn from the results, including sources of error

Learners should prepare and set up equipment in an appropriate manner for each experiment. They should deploy suitable practical techniques in accordance with prevailing safety requirements in the laboratory and ensure that their work produces accurate results. Learners should be observed on both occasions and a record should be kept of the observation.

Higher National Unit Support Notes

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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, which is both theoretical and practical, will provide learners with the scientific background that underpins the PDA in Food Science. It is aimed at learners who have not previously completed units in chemistry or a related science at SCQF level 6.

Learners are introduced to basic scientific concepts from chemistry and biology, and are also required to undertake laboratory work. This theoretical and practical foundation will give them suitable knowledge, understanding, skills and techniques to prepare them for other units in the PDA in Food Science, such as F6VC 34 *Food Analysis*, F6VD 34 *Food Composition* and F6VL 34 *Microbiology of Foods 1*.

When carrying out laboratory work learners should be made fully aware of the importance of safe working practices and the precautions, that should be taken to ensure that these are achieved. They should recognise the need to obtain accurate results, and the consequent requirement to conduct experiments carefully and according to the relevant procedure. They will be expected also to keep a record of their observations and results. Throughout, however, the intention is that learners should relate their work in the unit to the food industry. In this sense, the unit is also an applied unit.

Outcome 1 covers the cellular nature of food. Learners can cover the following:

Function of nucleus, cytoplasm, chloroplast, cell membrane and cell wall respiration, photosynthesis and osmosis.

Learners should be able to produce labelled diagrams of plant and animal cells.

Outcome 2 is more substantial than Outcome 1. It covers the principles of matter formation and the different types of matter related to the study of food technology. It can include the following:

- Atomic structure, ionic and covalent bonding, alkanes, alkenes, alkanols, alkanals, alkanones alkanoic acids and alkyl alkanoates (esters)
- Functional groups — hydroxyl, carbonyl, carboxyl and amino
- Solutes, solvents and solutions
- Sols, gels and emulsions
- Differences between physical and chemical changes
- Kinetic theory of matter related to changes in state
- Acidity, alkalinity and pH
- Humidity, relative and absolute
- Heat: change of state — latent heat; boiling point, melting point, specific heat capacity; heat transfer — conduction, convection and radiation

Learners should be able to use chemical formulae where appropriate when explaining chemical concepts.

Guidance on approaches to delivery of this unit

The delivery of this unit should take into account that will also help to prepare learners for scientifically based units in the PDA Food Science such as F6VD 34 *Food Composition*,F6VC 34 *Food Analysis* and F6VL 34*Microbiology of Foods 1*. Learners will be taking this unit because they have not achieved units in scientific subjects at SCQF level 6. It is possible that, in the past, they perhaps have found studying science difficult or uninteresting or both. Given the vital importance of scientific understanding and practical laboratory skills in the PDA in Food Science, it is important that the delivery methods adopted should engage the attention and interest of learners.

Wherever possible, delivery should encourage learners to be as active as possible. A combination of delivery methods may be one way to achieve this. This could range from direct exposition to asking learners to find out information for themselves. This could be done in groups who could be guided towards different research tasks. Groups could then share information. This can also help learners take responsibility for their own learning and help them to develop patterns of independent study. Wherever possible the material can be applied to the food industry so that learners recognise the importance of scientific knowledge and understanding to their study of food manufacturing. If learners realise this at an early stage, they are likely to approach later units with a positive attitude.

Outcome 2 covers a greater amount of material than Outcome 1 and it is likely, therefore, that, during the delivery process, learners will devote more time to the knowledge and/or skills items in Outcome 2 than to the knowledge and/or skills items in Outcome 1.

For the practical laboratory skills, the aim should be to build both skills and confidence so that learners are in a strong position to undertake the practical parts of units such as F6VL 34 *Microbiology of Foods 1* and F6VC 34 *Food Analysis*.

Higher National Unit Support Notes (cont)

Unit title: Science for the Food Industry: An Introduction (SCQF level 6)

Outcome 1

This outcome should be delivered in isolation and will cover the structural and functional features of the two eukaryotic cells; animal and plant cells. A focus on the nature of function within the food science arena would be ideally the conclusion of the knowledge and understanding. This will help to motivate learners who, in the past, did either not like studying the biological science or found it too theoretical. Experimental work, either student led or teacher demonstrated, will help to cement the role of cellular biology in food science. In particular skills in the use of microscopes, preparing micro-slides for animal and plant cells, experiments showing the products of photosynthesis and respiration, and practical work for osmosis.

Outcome 2

Being the larger of the two theoretical outcomes, more time will be spent in the delivery of this outcome. Where learners may have no previous knowledge in chemistry it would be advisable to start with the basic structure of the atom (protons, neutrons, and electrons) and the relationship the periodic table has with this structure. Moving quickly in to bonding theory, covalent, ionic and metallic, the topic of electronegativity will need to be touched on. This will then lead in to the intermolecular forces of attraction such as hydrogen bonding, permanent polar-polar attractions and London dispersion forces. An understanding of the relative strength of these forces of attraction/bonding will help with the understanding of physical features such as hardness/softness, melting/boiling points and viscosity.

Natural food based compounds and molecules could be chosen to help keep the chemistry in context.

Organic chemistry should start with the introduction to the simplest family of hydrocarbons, the alkanes and progress to alkenes, alkanols, alkanals, alkanones and alkanoic acids. Reaction schemes for the synthesis of the above molecules should be taught and then progression to synthesis of esters. The reverse reactions could also be taught.

During the introduction of each organic family, it would be wise to discuss the different functional groups and how these groups affect the physical properties based upon the intermolecular forces of attraction. The contextual relationship to food science must be brought in to any discussion so as to continue to ensure motivation and interest with learners. There is always, therefore, opportunities to build in practical lab activities that relate food science to the chemistry.

Amines, amino acids and amides should be commented on — in particular because of the strong link these have in protein biochemistry.

The chemistry of solutions and colloidal suspensions should be taught and in particular specific food science solutions, colloids or emulsions. Learners will be able to explain the nature of these substances and why they display their properties.

The pH scale will be taught with reference to the concentration of hydrogen ions that are present in aqueous solutions. The balance in [H+] and [OH-] will be taught and calculations of pH will be performed for both strong acidic and alkaline solutions using the relationships [H+][OH-] = 1x10-14 and pH=-log[H+].

Weak acids and alkalis will be mentioned with reference only to the partial dissociation of ions when in aqueous solutions. This will give an opportunity to contextualise using organic acids and amines.

Heat, in particular Latent heat of melting or boiling, and Specific Heat from heat transfer (conduction or convection) should be taught using theory but will lend itself greatly to experimental lab work. $E_h = m\ l$, and $E_h = c\ m\ \Delta T$ will be used a physical equations for calculating the quantity of heat energy.

Outcome 3

Practical laboratory experiments should be used to aid with the understanding of the theory from Outcomes 1 and 2. There should be the opportunity to perform a number of experiments ranging from the preparation of animal and plant cell slides and using scientific microscopes to organic chemistry synthesis to physical chemistry specific heat measurements. Learners must complete a minimum of two laboratory exercises that have been performed safely, accurately and correctly reported in a laboratory notebook.

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.

Assessment for this unit tests the understanding of learners and their practical work. Assessment for this unit could take a variety of ways. For example, knowledge and understanding can be assessed through questions which ask learners to explain relevant scientific concepts and, where appropriate, relate them to the food industry. Learners could be asked to present their responses to these questions in a number of different ways, eg they could group their responses together in the form of a short report or they could prepare a simple poster presentation. Alternatively, they could make use of presentation software (such as Powerpoint) or use tools from a virtual learning environment.

Practical work can be assessed by observation and through reports on experimental work. Learners should be observed during some of their work and the observation should be recorded on a checklist (photographic and/or video evidence could be used to supplement the checklist). This will provide evidence that learners have followed proper laboratory procedures and carried out the work safely and accurately. If necessary, the observation checklists may be supplemented by additional questions. Learners must also provide reports of their experiments as reports also form part of the assessment, with the evidence including referencing where appropriate. They could also use a laboratory notebook to do this.

Learners could submit a portfolio of work covering all the assessment for this unit. They could build the portfolio during their study of the unit. In this way, assessment can arise naturally out of the delivery process.

Assessment guidelines

Outcome 1

Learners could be asked to generate evidence by giving responses to specific questions. These could be presented in the form of a short report or in another suitable presentation format. This work could be combined with the evidence for Outcomes 2 and 3 and presented in a portfolio.

Outcome 2

Learners could be asked to generate evidence by giving responses to specific questions. These could be presented in the form of a short report or in another suitable presentation format. This work could be combined with the evidence for Outcomes 1 and 3 and presented in a portfolio.

Outcome 3

Learners can present the evidence of their practical work in a laboratory logbook. An observation checklist can be used to record the achievement of practical skills such as safe laboratory practice. Learners could be asked questions about the work they have done to supplement the observation checklist and the recording of analyses.

The work for this outcome could be incorporated into a portfolio of work which also includes evidence for Outcomes 1 and 2.

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**.

Higher National Unit Support Notes (cont)

Unit title: Science for the Food Industry: An Introduction (SCQF level 6)

Opportunities for developing Core and other essential skills

Communication: Written Communication (Writing) at SCQF level 4

As part of their work for this unit, learners are expected to maintain details of experimental work in a laboratory notebook. Depending on the method of presentation used, they may also be expected to use written information to demonstrate/convey their knowledge and understanding of scientific concepts. For this, they will be required to make use of a logical structure and use appropriate vocabulary to accurately convey meaning to first reading.

The delivery and assessment of this unit will also provide learners with the opportunity to develop the Core Skills of *Problem Solving* at SCQF level 5, and *Information and Communication Technology (ICT)* at SCQF level 4.

Problem Solving: Reviewing and Evaluating at SCQF level 5

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

Information and Communication Technology (ICT): Providing/Creating Information at SCQF level 4

Learners will 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 specialist chemical structure software.

History of changes to unit

Version	Description of change	Date
03	Unit content has been transferred to a new shell and typographical amendments made to wording throughout.	10/06/19
02	Titles of units F6VD 34 and F6VC 34 amended by removal of numeral 1 in line with QDT agreement.	26/04/10

General information for learners

Unit title: Science for the Food Industry: An Introduction (SCQF level 6)

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 unit is a mandatory unit in the PDA HNC Food Science. It is designed to help you gain the underpinning knowledge and understanding of the use of science in the food industry. It also gives you some of the scientific background that you will need to fully understand methods of food processing. It will be particularly useful if you have not previously studied scientific subjects or have not done so for a long time. Foods are chemical compounds and food processing can involve changing the physical properties of these compounds so scientific knowledge and understanding is crucial to the operation of the food industry.

The unit is both theoretical and practical. It introduces you to scientific concepts from chemistry in particular, but also from physics, and shows how these can be applied to the food industry. It also gives you an opportunity to do some laboratory work and develop practical scientific skills that you will need for other units in your PDA. After completing the unit you will have a good basis in fundamental scientific principles relevant to the food industry and have some valuable practical laboratory skills. You will be able to all of this in later units in the PDA in Food Science.

The unit will ensure you have the knowledge to understand the following:

- Plant and animal cells
- Cell structure in relation to function
- Respiration, photosynthesis and osmosis
- Structure of molecules and compounds
- Properties of compounds
- Carbon compounds
- Functional groups and homologous series
- Solutions and colloidal suspensions
- Acidity and alkalinity
- Heat Energy — Latent Heat and Specific Heat

The assessment for this unit will require you to show that you can accurately explain scientific concepts and principles. You will also have to successfully complete practical laboratory work. You will be observed while you are doing this and will also have to keep records of work that you have done in the laboratory.

You will have succeeded in meeting all the requirements of this unit if you pass this assessment.