SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Cell Biology (Higher)

NUMBER D029 12

COURSE Biology (Higher)

SUMMARY

The unit seeks to develop knowledge and understanding, problem solving and practical abilities in the context of cell structure in relation to function, photosynthesis, energy release, the synthesis and release of proteins and cellular response in defence. This is a component unit of Higher Biology.

OUTCOMES

1 Demonstrate knowledge and understanding related to cell biology.
2 Solve problems related to cell biology.
3 Collect and analyse information related to Higher Biology obtained by experiment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following:

- Standard Grade Biology with Knowledge and Understanding and Problem Solving at Credit level
- Intermediate 2 Biology.

In particular, candidates should have a clear understanding of the Standard Grade Biology topics of photosynthesis, cell structure, cell respiration and diffusion, or have achieved the unit: *Living Cells (Int 2).*

Administrative Information

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National Unit Specification: general information (cont)

UNIT Cell Biology (Higher)

CREDIT VALUE

1 credit at Higher.

CORE SKILLS

Core skills for this qualification remain subject to confirmation and details will be available at a later date.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Cell Biology (Higher)

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 the Scottish Qualifications Authority.

OUTCOME 1

Demonstrate knowledge and understanding related to cell biology.

Performance criteria

(a) Cell structure is described correctly in relation to function.
(b) Photosynthesis is described correctly in terms of the role of light and photosynthetic pigments, photolysis and carbon fixation.
(c) Energy release is described correctly in relation to the role and production of ATP.
(d) The synthesis and release of proteins is described correctly in terms of the role of DNA, RNA and cellular organelles.
(e) Cellular response in defence is described correctly in relation to animals and plants.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed-book test with items covering all the above performance criteria.

OUTCOME 2

Solve problems related to cell biology.

Performance criteria

(a) Relevant information is selected and presented in an appropriate format.
(b) Information is accurately processed, using calculations where appropriate.
(c) Conclusions drawn are valid and explanations given are supported by evidence.
(d) Experimental procedures are planned, designed and evaluated appropriately.
(e) Predictions and generalisations made are based on available evidence.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed-book test with items covering all the above performance criteria. Problems must be set in the context of cell structure in relation to function, photosynthesis, energy release, the synthesis and release of proteins or cellular response in defence.

National Unit Specification: statement of standards (cont)

UNIT Cell Biology (Higher)

OUTCOME 3

Collect and analyse information related to Higher Biology obtained by experiment.

Performance criteria

(a) The information is collected by active participation in the experiment.
(b) The experimental procedures are described accurately.
(c) Relevant measurements and observations are recorded in an appropriate format.
(d) Recorded experimental information is analysed and presented in an appropriate format.
(e) Conclusions drawn are valid.
(f) The experimental procedures are evaluated with supporting argument.

Evidence requirements

A report of one experimental activity is required, covering the above performance criteria and related to the contents and notes specified for Higher Biology.

The teacher/lecturer responsible must attest that the report is the individual work of the candidate derived from active participation in an experiment involving the candidate in planning the experiment; deciding how it is managed; identifying and obtaining the necessary resources, some of which must be unfamiliar; and carrying out the experiment. Depending on the activity, the collection of the information may be group work.

Evidence submitted in support of attainment of PC (d) must be in the format of a table or graph(s) as appropriate. Conclusions drawn should be justified by reference to supporting evidence.

The evaluation should cover all stages of the experiment, including the initial analysis of the situation and planning and organising the experimental procedure.

National Unit Specification: support notes

UNIT Cell Biology (Higher)

This part of the unit specification is offered as guidance. The support notes 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 CONTENT AND CONTEXT FOR THIS UNIT

Outcome 1

a) Cell structure in relation to function

i Cell variety.
The concept of variation in structure between cells of one type of tissue and between cells of different types of tissue.
The existence of unicellular organisms.
The relationship of structure to function.

ii Absorption and secretion of materials.
Diffusion and osmosis as basic cell processes. The role of the cell wall and plasma membrane in relation to these processes.
Cell wall: reference to cellulose fibres and permeability.
Plasma membrane: reference to fluid mosaic model.
Function of plasma membrane in relation to selective ion uptake (active transport) and absorption and release of chemicals.

b) Photosynthesis

1 The role of light and photosynthetic pigments.
- i Absorption, transmission and reflection of light by a leaf.
- ii Role of chlorophyll and other photosynthetic pigments.
- iii Separation of photosynthetic pigments by means of chromatography.

2 The light dependent stage and carbon fixation

The detailed structure of chloroplasts should be related to the stages of photosynthesis.

i Photolysis
The location and significance of the light dependent stage.
The production of ATP and hydrogen (for use in carbon fixation).

ii The location and significance of carbon fixation (Calvin cycle).
The production of glucose as a result of an enzyme-controlled sequence of reactions requiring ATP, hydrogen (from photolysis) and carbon dioxide.

National Unit Specification: support notes (cont)

UNIT Cell Biology (Higher)

c) Energy release

The role and production of ATP:

i Importance of ATP as a means of transferring chemical energy. The role of ATP in cellular processes. Regeneration of ATP from adenosine diphosphate (ADP) and inorganic phosphate (Pi).

ii Glycolysis.
The breakdown of glucose (6C) to pyruvic acid (3C) with a net production of ATP. Location of process within the cytoplasm.

iii Krebs (Tricarboxylic acid, Citric acid cycle).
The production of carbon dioxide and hydrogen.

iv The cytochrome system.
The production of ATP and water.

v Mitochondrion structure

vi Distinction between aerobic and anaerobic phases of respiration with reference to the level of ATP production and final metabolic products.

d) Synthesis and release of proteins

The role of DNA, RNA and cellular organelles:

i The functional variety of proteins.

ii DNA: structure, in particular the double helix, nucleotides and bases; pairing of named bases; genes as regions of chromosomal DNA; the process of DNA replication and its importance.

iii RNA: single strand structure; replacement of thymine with uracil and deoxyribose with ribose; functions of mRNA and tRNA in synthesis of proteins; triplet code; codons and anti-codons.

iv Cellular organelles: ribosomes and rough endoplasmic reticulum. Distribution within the cell and function as site of translation in protein synthesis; role of endoplasmic reticulum in transporting proteins; role of Golgi apparatus in processing molecules for secretion.

e) Cellular response in defence in animals and plants

i The nature of viruses and their invasion of cells.
Alteration of cell instructions to produce more viruses.

ii Cellular defense mechanisms in animals.
Phagocytosis.
Antibody production.

iii Cellular defence mechanisms in plants.

Further detail is given in the supplementary notes in the course content section of the course specification.

National Unit Specification: support notes (cont)

UNIT Cell Biology (Higher)

Outcome 2

Examples of learning activities which provide suitable contexts for the development of problem solving skills include:

- design and carry out an investigation to measure the water concentration of cell sap using plant tissue
- examine and interpret data concerning solute concentrations in aquatic organisms and their environment
- analyse data on limiting factors affecting photosynthesis
- design and carry out an investigation to show the activity of dehydrogenase enzymes in yeast
- obtain information from a variety of sources on the nature of DNA and RNA and their roles in protein synthesis
- obtain and present information on tissue transplantation including the problem of tissue rejection and the use of suppressors
- analyse data on palatability of cyanogenic and non-cyanogenic clover to herbivores.

Outcome 3

Suitable experiments in the context of this unit include:

- the chemical nature of the plasma membrane
- extraction and separation of leaf pigments by paper chromatography
- separation of photosynthetic pigments by means of thin layer chromatography
- dehydrogenase activity in yeast
- measuring the water concentration of cell sap using plant tissue.

Candidates or centres could devise other appropriate experiments in the context of cell structure in relation to function, photosynthesis, energy release, the synthesis and release of proteins or cellular response in defence in animals and plants.

The experiments chosen should allow all the performance criteria for this outcome to be achieved within any single report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Details of suitable approaches are detailed in the course specification.

National Unit Specification: support notes (cont)

UNIT Cell Biology (Higher)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

It is recommended that a holistic approach is taken to assessment, eg Outcomes 1 and 2 could be assessed by an integrated end of unit test with questions covering all the performance criteria for knowledge and understanding and problem solving.

Outcome 2

Test items should be constructed to allow candidates to generate evidence relating to the performance criteria as follows:

a) Selecting and presenting information:
- sources of information to include: texts, tables, charts, graphs and diagrams
- formats of presentation to include: written summaries, extended writing, tables and graphs.

b) Calculations to include: percentages, averages, ratios. Significant figures and units should be used appropriately.

c) Conclusions drawn should include some justification, and explanations should be supported by evidence. Conclusion could contain a comment on trends or patterns and/or connections between variables and controls.

d) Candidates could plan and design procedures to test given hypotheses or to illustrate particular effects. This could include identification of variables, controls and measurements or observations required. The evaluation of given experimental procedures may include situations which are unfamiliar to candidates and could test the candidates' ability to comment on the purpose of approach or the suitability of given experimental procedures. Candidates could comment on the limitations of the set-up, apparatus, suggested measurements or observations, limitations of equipment, appropriateness of controls, sources of error and possible improvements.

e) Candidates could make predictions and generalisations from given experimental results or, given situations, predict what the results might be.

National Unit Specification: support notes (cont)

UNIT Cell Biology (Higher)

Outcome 3

Type of experimental activity

The teacher/lecturer should ensure that the experimental activity to be undertaken in connection with Outcome 3 affords opportunity for the candidate to demonstrate the ability to undertake the planning and organising of an experimental activity at an appropriate level of demand. The activity must relate to the Course content and candidates should be made aware of the range of skills which must be demonstrated to ensure attainment of Outcome 3.

Assessment of Outcome 3

Candidates are only required to produce one report for Outcome 3 in relation to the contents and notes specified for Higher Biology. This report can then be used as evidence for Outcome 3 for the other units of the course.

In relation to PC (a), the teacher/lecturer checks by observation that the candidate participates in the collection of the experimental information by playing an active part in planning the experiment, deciding how it will be. managed, identifying and obtaining resources (some of which must be unfamiliar to the candidate), and carrying out the experiment.

National Unit Specification: support notes (cont)

UNIT Cell Biology (Higher)

Candidates should provide a report with an appropriate title. The report should relate to the performance criteria as follows:

(b) The experimental procedures are described accurately.	A clear statement of the aim of the experiment. A few brief concise sentences including as appropriate: • a labelled diagram or brief description of apparatus or instruments used • how the independent variable was altered • control measure used • how measurements were taken or observations made. There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the performance criteria.
(c) Relevant measurements and observations are recorded in an appropriate format.	Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.
(d) Recorded experimental information is analysed and presented in an appropriate format.	Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent, as appropriate: • For a tabular presentation this may be an extension of the table used for PC (c) above, and must include: suitable headings and units showing averages or other appropriate computations. • For a graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with variable and units and with data correctly plotted.
(e) Conclusions drawn are valid.	Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included: • overall pattern to readings or observations (raw data) • trends in analysed information or results • connection between variables and controls.
(f) The experimental procedures are evaluated with supporting argument.	The evaluation could cover all stages of the activity including preparing for the activity, analysis of the activity and the results of the activity. The evaluation must include supporting argument in at least one of the following: • effectiveness of procedures • control of variables • limitations of equipment • possible sources of error • possible improvements.

National Unit Specification: support notes (cont)

UNIT Cell Biology (Higher)

The bullet points under each performance criterion give an indication of what should be addressed to achieve a pass. The relevance of the bullet points will vary according to the experiment. These bullet points are intended as helpful guidance. The decision of pass or fail is to be made by the professional judgement of the presenting centre (subject to moderation) against the performance criteria. It is appropriate to support candidates in producing a report to meet the performance criteria. Re-drafting of a report after necessary supportive criticism is to be encouraged, both as part of the learning and teaching process and to produce evidence for assessment. Redrafting and resubmission is only required for the specific performance criterion identified in need of further attention ie the entire report does not need to be rewritten.

Conditions required to complete the report

Candidates may complete their reports outwith class time provided reasonable measures are taken to ensure that the report is the individual work of the candidate.

Teachers and lecturers may wish candidates to write up reports under their direct supervision so that they can provide appropriate advice and support. However, they may feel confident that any redrafting required need not be undertaken under such close supervision as it will be evident in the candidate's response that it is his or her unaided work. Under such circumstances it would be acceptable for such redrafting to take place outwith class time.

Use of IT

Candidates may, if they wish, present their reports in a word-processed format. Candidates may use Excel (or any other suitable data analysis software) when tackling Outcome 3. However, candidates must not be given a spreadsheet with pre-prepared column headings nor formulae, as they are being assessed on their ability to enter quantities and units into a table and to make decisions about appropriate scales and labels on graph axes. The use of clip art or images captured by digital camera may also be used in recording details of experimental methods.

Transfer of evidence

Candidates may transfer evidence for Outcome 3 from one level to the one below provided the experiment is in the context of the course concerned eg. a report on measuring water concentration in cell sap could be transferred to Intermediate 2 since it is in the context of osmosis. However, a report on chromatography of photosynthetic pigments could not be transferred to Intermediate 2 since there is no equivalent context at this level.

Candidates, who are repeating a course, may carry forward evidence of an appropriate standard, generated in a previous year.

National Unit Specification: support notes (cont)

UNIT Cell Biology (Higher)

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, 2001).