

National Unit Specification: general information

UNIT	Control and Regulation (Higher)
NUMBER	D031 12
COURSE	Biology (Higher)

SUMMARY

The unit seeks to develop knowledge and understanding and problem solving in the context of variation, selection and speciation, and animal and plant adaptations. This is a component unit of Higher Biology.

OUTCOMES

- 1 Demonstrate biological knowledge and understanding related to control and regulation.
- 2 Solve problems related to control and regulation.
- 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.

Administrative Information

Superclass:	RH
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In particular, candidates should have a clear understanding of the Standard Grade Biology topics of the effect of environmental conditions on plants, cell division, chromosomes, genes, control by chromosomes, abiotic factors, ecosystems, feeding relationships, energy flow, population growth, controlling factors, control and management in ecosystems, water balance, kidney structure and function, the need for food, diffusion, osmosis and enzyme activity. Alternatively, candidates should have achieved the units: *Living Cells (Int 2)*, *Environmental Biology and Genetics (Int 2)* and *Animal Physiology (Int 2)*.

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 Control and Regulation (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 biological knowledge and understanding related to control and regulation.

Performance criteria

- (a) Control of growth and development is described correctly in terms of growth differences between plants and animals, genetic control, hormonal influences, and environmental influences.
- (b) Physiological homeostasis is described correctly in relation to the principle of negative feedback.
- (c) Population dynamics is described correctly in relation to regulation of plant and animal populations.

Evidence requirements

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

OUTCOME 2

Solve problems related to control and regulation.

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 the control of growth and development, physiological homeostasis or population dynamics.

National Unit Specification: statement of standards (cont)

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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 in relation 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

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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) Control of growth and development

- 1 Growth differences between plants and animals.
 - i Position and activity of meristems in plants, absence of meristems in animals.
 - ii Formation of annual rings.
 - iii Regeneration in angiosperms and mammals.
 - iv Growth patterns in plants and animals to include an annual plant, a tree, a human and a locust.

- 2 Genetic control.
 - i An introduction to the Jacob-Monod hypothesis of gene action in bacteria.
 - ii The part played by genes in controlling metabolic pathways as shown in the case of phenylketonuria.
 - iii The control of cell differentiation by switching particular genes on or off.

- 3 Hormonal influences.
 - i Pituitary hormones.
The role of the pituitary gland in the control of growth and development involving human growth hormone (GH) and thyroid stimulating hormone (TSH).
 - ii Plant growth substances.
As exemplified by indole acetic acid (IAA) and gibberellic acid (GA).
Sites of production of IAA. Effects of IAA at cellular and organ levels; role in apical dominance, leaf abscission, fruit formation.
Effects of GA on dormancy and in dwarf varieties of plants.
Role of GA in α -amylase induction in barley grains.
Practical applications of plant growth substances as illustrated by herbicides and rooting powders.

- 4 Environmental influences.
 - i The importance of individual macro-elements.
Symptoms of deficiency of nitrogen, phosphorus, potassium and magnesium in plants.
The importance of iron and calcium in animals.
The inhibiting effect of lead on enzyme activity.
 - ii The effect of vitamin D deficiency in humans.
 - iii The effect of drugs on fetal development: thalidomide, alcohol, nicotine.
 - iv Light.
The effect of light on vegetative shoot growth and development.
The effect of light on flowering in long-day and short-day plants.
The effect of light on the timing of breeding in birds and mammals.

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b) Physiological homeostasis

The principle of negative feedback:

- i The need to maintain conditions within tolerable limits.
- ii Water content of blood and concentration of cell chemicals.
- iii Glucose and energy needs of tissue.
- iv Temperature: the importance of temperature to enzyme – controlled metabolic processes in the body.
- v Endotherms and ectotherms.

c) Population dynamics

Regulation of plant and animal populations:

- i Population fluctuations: the relative stability of populations, despite short-term oscillations in number.
- ii Factors influencing population change.
Density-independent factors to include temperature and rainfall.
Density-dependent factors to include disease, food supply, predation and competition.
- iii Monitoring populations.
The need to monitor wild populations.
- iv Succession and climax in plant communities.

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

Outcome 2

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

- obtain and present information on growth patterns in a variety of organisms including an annual plant, a tree, a human and a locust
- obtain and present information on the nature and occurrence of phenylketonuria
- design and carry out an investigation to compare the effects of different concentrations of a plant growth substance on plant growth
- analyse data on the effect of alcohol or nicotine on birthweight
- analyse data on kidney function
- obtain and present information on blood sugar concentrations in diabetic and non-diabetic humans
- obtain and present information on fluctuations in plant and animal populations
- design and carry out an investigation into the density of a suitable organism in relation to different environmental conditions
- analyse data to show density independence
- analyse data to illustrate predator/prey interactions, perhaps using a computer simulation.

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Outcome 3

Examples of suitable experiments in the context of this unit include:

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- the effects of indole acetic acid (IAA) on root growth in mustard seedlings
- the role of gibberellic acid (GA) in α -amylase induction in barley grains
- induction of the lac operon in *E. coli*
- the effects of different minerals on plant growth
- inhibition of catechol oxidase by lead
- human body response to sudden heat loss
- the density of woodlice in relation to different environmental conditions.

Candidates or centres could devise other appropriate experiments in the context of the control of growth and development, physiological homeostasis and population dynamics.

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.

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 reported by evidence. Conclusions could contain a comment on trends or patterns and/or connections between variables and controls.

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- 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.

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.

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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.	<p>A clear statement of the aim of the experiment.</p> <p>A few brief concise sentences including as appropriate:</p> <ul style="list-style-type: none">• 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. <p>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.</p>
(c) Relevant measurements and observations are recorded in an appropriate format.	<p>Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.</p>
(d) Recorded experimental information is analysed and presented in an appropriate format.	<p>Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent, as appropriate:</p> <ul style="list-style-type: none">• 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.	<p>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:</p> <ul style="list-style-type: none">• 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.	<p>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:</p> <ul style="list-style-type: none">• effectiveness of procedures• control of variables• limitations of equipment• possible sources of error• possible improvements.

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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 work 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.

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

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).