National 5
Course Assessment
Specification

National 5 Biology Course Assessment Specification

Valid from August 2013

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Please refer to the note of changes at the end of this *Course Assessment Specification* for details of changes from previous version (where applicable).

Course outline

Course title: National 5 Biology

SCQF level: 5 (24 SCQF credit points)

Course code: to be advised

Course assessment code: to be advised

The purpose of the Course Assessment Specification is to ensure consistent and transparent assessment year on year. It describes the structure of the Course assessment and the mandatory skills, knowledge and understanding that will be assessed.

Course assessment structure

Component 1 — question paper	80 marks
Component 2 — assignment	20 marks
Total marks	**100 marks**

This Course includes six SCQF credit points to allow additional time for preparation for Course assessment. The Course assessment covers the added value of the Course.

Equality and inclusion

This Course Assessment Specification has been designed to ensure that there are no unnecessary barriers to assessment. Assessments have been designed to promote equal opportunities while maintaining the integrity of the qualification.

For guidance on assessment arrangements for disabled learners and/or those with additional support needs, please follow the link to the Assessment Arrangements web page: www.sqa.org.uk/sqa/14977.html.

Guidance on inclusive approaches to delivery and assessment of this Course is provided in the *Course Support Notes*.

Assessment

To gain the award of the Course, the learner must pass all of the Units as well as the Course assessment. Course assessment will provide the basis for grading attainment in the Course award.

Course assessment

SQA will produce and give instructions for the production and conduct of Course assessments based on the information provided in this document.

Added value

The purpose of the Course assessment is to assess added value of the Course as well as confirming attainment in the Course and providing a grade. The added value for the Course will address the key purposes and aims of the Course, as defined in the Course Rationale. It will do this by addressing one or more of breadth, challenge, or application.

In this Course assessment, added value will focus on the following:

- breadth — drawing on knowledge and skills from across the Course
- challenge — requiring greater depth or extension of knowledge and/or skills
- application — requiring application of knowledge and/or skills in practical or theoretical contexts as appropriate

This added value consists of:

- a question paper, which requires learners to demonstrate aspects of breadth, challenge and application; learners will apply breadth and depth of skills, knowledge and understanding from across the Course to answer questions in biology
- an assignment, which requires learners to demonstrate aspects of challenge and application; learners will apply skills of scientific inquiry, using related knowledge, to carry out a meaningful and appropriately challenging task in biology and communicate findings

Grading

Course assessment will provide the basis for grading attainment in the Course award.

The Course assessment is graded A–D. The grade is determined on the basis of the total mark for all Course assessments together.

A learner's overall grade will be determined by their performance across the Course assessment.

Grade description for C
For the award of Grade C, learners will have demonstrated successful performance in all of the Units of the Course. In the Course assessment, learners will typically have demonstrated successful performance in relation to the mandatory skills, knowledge and understanding for the Course.

Grade description for A
For the award of Grade A, learners will have demonstrated successful performance in all of the Units of the Course. In the Course assessment, learners will typically have demonstrated a consistently high level of performance in relation to the mandatory skills, knowledge and understanding for the Course.

In addition, learners achieving a Grade A will have demonstrated a high overall level of performance by:

- retaining knowledge and understanding over a long period of time
- showing a deeper level of knowledge and understanding
- integrating and applying skills, knowledge and understanding across the three component Units of the Course
- displaying problem solving skills in less familiar and more complex contexts
- applying skills of scientific inquiry and analytical thinking in complex contexts that involve more complex data

Credit
To take account of the extended range of learning and teaching approaches, remediation, consolidation of learning and integration needed for preparation for external assessment, six SCQF credit points are available in Courses at National 5 and Higher, and eight SCQF credit points in Courses at Advanced Higher. These points will be awarded when a grade D or better is achieved.

Structure and coverage of the Course assessment

The Course assessment will consist of two Components: a question paper and an assignment. The question paper will have two Sections. The assignment will have one Section.

Component 1 — question paper
The purpose of the question paper is to assess breadth and depth of knowledge and understanding from across the Units.

The paper will assess scientific inquiry skills, analytical thinking skills and the impact of applications on society and the environment.

The question paper will give learners an opportunity to demonstrate the following skills, knowledge and understanding by:

- demonstrating knowledge and understanding of biology by making statements, describing information, providing explanations and integrating knowledge
- applying knowledge of biology to new situations, interpreting information and solving problems
- planning or designing experiments/investigations to test given hypotheses or to illustrate particular effects, applying safety measures
- selecting and presenting information appropriately in a variety of forms
- processing information (using calculations and units, where appropriate)
- making predictions and generalisations based on evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- identifying a source of error and suggesting improvements to experiments

The mandatory skills and knowledge are specified in the 'Further mandatory information on Course coverage' section at the end of this Course Assessment Specification.

The question paper will have 80 marks (80% of the total mark)

The question paper will have two Sections.

Section 1, titled 'Objective Test', will have 20 marks.

Section 2, titled 'Paper 2', will contain restricted and extended response questions and will have 60 marks.

Marks will be distributed approximately proportionately across the Units.
The majority of the marks will be awarded for applying knowledge and understanding.
The other marks will be awarded for applying scientific inquiry, scientific analytical thinking and problem solving skills.

Component 2 — assignment
The purpose of the assignment is to allow the learner to carry out an in depth study of a biology topic. The topic will be chosen by the learner, who will investigate/research the underlying biology and the impact on society/the environment.

The assignment will assess the application of skills of scientific inquiry and related biology knowledge and understanding.

The assignment will have 20 marks (20% of the total marks).

The majority of the marks will be awarded for applying scientific inquiry and analytical thinking skills. The other marks will be awarded for applying related knowledge and understanding.

In preparation for the controlled assessment, the learner will carry out an investigation stage:

- select an appropriate biology topic, within the set guidelines provided by SQA
- investigate/research the topic, focusing on applications and impact on society/the environment
- process the information/data collected

In the controlled assessment stage, the learner will present evidence of:

- the process they have undertaken
- biology knowledge and understanding related to the topic investigated/researched
- the application of the topic
- a balanced evaluation of the impact on society/the environment
- a reasoned conclusion

Setting, conducting and marking of assessment

Question paper

This question paper will be set and marked by SQA, and conducted in centres under conditions specified for external examinations by SQA. Learners will complete this in 2 hours.

Controlled assessment — assignment

This assignment is:

- set by centres within SQA guidelines
- conducted under a high degree of supervision and control

Evidence will be submitted to SQA for external marking.

All marking will be quality assured by SQA.

Setting the assessment

Set by centres within SQA guidelines.

Conducting the assessment

Conducted under a high degree of supervision and control.
Learners will carry out the investigation stage in no more than 7 hours.

Learners will complete the controlled assessment stage in no more than 1 hour and under open-book supervised conditions.

SQA will provide an assignment specification for the generation of evidence. Learners will have a choice of topic to be investigated/researched. SQA will specify the extent of the material to be taken into the controlled assessment.

The production of evidence for the assessment will be carried out:

- with the use of specified resources
- in time to meet a submission date set by SQA
- independently by the learner

Further mandatory information on Course coverage

The following gives details of mandatory skills, knowledge and understanding for the National 5 Biology Course. Course assessment will involve sampling the skills, knowledge and understanding. This list of skills, knowledge and understanding also provides the basis for the assessment of Units of the Course.

The following gives details of the skills:

- demonstrating knowledge and understanding of biology by making statements, describing information, providing explanations and integrating knowledge
- applying biology knowledge to new situations, interpreting information and solving problems
- planning, designing, and safely carrying out investigations/experiments to test given hypotheses or to illustrate particular effects
- selecting information from a variety of sources
- presenting information appropriately in a variety of forms
- processing information (using calculations and units, where appropriate)
- making predictions and generalisations based on evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- suggesting improvements to investigations/experiments
- communicating findings/information

These skills will be assessed, across the Course, in the context of the mandatory knowledge.

The following table specifies the mandatory knowledge for the National 5 Biology Course.

Cell Biology
1 Cell structure Cell ultrastructure and functions to include cell walls, mitochondria, chloroplasts, cell membrane, vacuole, nucleus, ribosomes and plasmids using examples from typical plant, animal, fungi and bacteria cells.
2 Transport across cell membranes a. The cell membrane consists of lipids and proteins and is selectively permeable. b. Passive transport is with the concentration gradient and does not require energy. c. The importance of diffusion in cells as the movement of molecules along a concentration gradient. d. Osmosis as the movement of water molecules across a membrane in terms of water concentration. e. Animal cells can burst or shrink and plant cells can become turgid or plasmolysed in different solutions. f. Active transport requires energy for membrane proteins to move molecules against the concentration gradient.

3 Producing new cells

a. Maintenance of diploid chromosome complement by mitosis.
b. Sequence of events of mitosis, including equator and spindle fibres.
c. Cell production by cell culture requires aseptic techniques, an appropriate medium and the control of other factors.

4 DNA and the production of proteins

a. Structure of DNA: double-stranded helix held by complementary base pairs. DNA carries the genetic information for making proteins. The four bases A, T, C & G make up the genetic code. The base sequence determines amino acid sequence in protein
b. Messenger RNA (mRNA) is a molecule which carries a copy of the code from the DNA, in the nucleus, to a ribosome, where the protein is assembled from amino acids.

5 Proteins and enzymes

a. The variety of protein shapes and functions arises from the sequence of amino acids.
b. Functions of proteins to include structural, enzymes, hormones, antibodies.
c. Enzymes function as biological catalysts and are made by all living cells. They speed up cellular reactions and are unchanged in the process. The shape of the active site of enzyme molecules is complementary to a specific substrate.
d. Each enzyme works best in its optimum conditions. Enzymes and other proteins can be affected by temperature and pH, which result in changes in their shape. A change in shape will affect the rate of reaction and may result in denaturation.

6 Genetic engineering

Genetic information can be transferred from one cell to another naturally or by genetic engineering. Stages of genetic engineering to include: identify section of DNA that contains required gene from source chromosome, extract required gene, insert required gene into vector/bacterial plasmid, insert plasmid into host cell and grow transformed cells to produce a GM organism.

7 Photosynthesis

a. Chemistry of photosynthesis, as a series of enzyme-controlled reactions, in a two-stage process.
   Light reactions: the light energy from the sun is trapped by chlorophyll in the chloroplasts and is converted into chemical energy in the form of ATP. Water is split to produce hydrogen and oxygen. Excess oxygen diffuses from the cell.
   Carbon fixation: hydrogen and ATP produced by the light reaction is used with carbon dioxide to produce sugar.
b. The chemical energy in sugar is available for respiration or can be converted into plant products such as starch and cellulose.
c. Limiting factors: carbon dioxide concentration, light intensity and temperature and their impact on photosynthesis and cell growth.

8 Respiration

a. The chemical energy stored in glucose must be released by all cells through a series of enzyme-controlled reactions called respiration.
b. The energy released from the breakdown of glucose is used to generate ATP

from ADP and phosphate. The chemical energy stored in ATP can be released by breaking it down to ADP and phosphate. This energy can be used for cellular activities including muscle cell contraction, cell division, protein synthesis and transmission of nerve impulses. ATP can be regenerated during respiration.

The breakdown of each glucose molecule via pyruvate to carbon dioxide and water in the presence of oxygen yields 38 molecules of ATP.

The breakdown of each glucose molecule via the fermentation pathway yields two molecules of ATP when oxygen is not present. Breakdown of glucose to lactic acid via pyruvate in animal cells. Breakdown of glucose to alcohol/ethanol and carbon dioxide via pyruvate in plant and yeast cells.

c. Fermentation occurs in the cytoplasm. Aerobic respiration starts in the cytoplasm and is completed in the mitochondria.

Multicellular Organisms

1 Cells, tissues and organs

Specialisation of cells, in animals and plants, leads to the formation of a variety of tissues and organs.

2 Stem cells and meristems

a. Stem cells are the sites of production of specialised cells in animals and have the potential to become different types of cell. Stem cells are involved in growth and repair.

b. Meristems are the sites of production of non-specialised cells in plants and are the only sites for cell division in a plant. These cells have the potential to become any type of plant cell and they contribute to plant growth.

3 Control and communication

a. Nervous control

Nervous control in animals, including structure and function of central nervous system (CNS). Brain structure: cerebrum, cerebellum and medulla.

b. Rapid reflex action and reflex arc: sensory, relay and motor neurons.

Receptors detect sensory input/stimuli. Electrical impulses move along neurons. A synapse occurs between neurons, allowing chemicals to transfer from one neuron to another.

c. Hormonal control

Endocrine glands release hormones into the blood stream. Hormones are chemical messengers. Target tissues have cells with receptors for hormones, so only some tissues are affected by specific hormones.

d. Blood glucose regulation to include insulin, glucagon, glycogen, pancreas and liver.

4 Reproduction

a. Body cells are diploid.

The structures and sites of gamete production in plants and animals.

b. The fertilisation of haploid gametes to produce a diploid zygote.

5 Variation and inheritance

a. Comparison of discrete and continuous variation.

b. Most features of an individual phenotype are polygenic and show continuous variation.

c. Identification of phenotype and genotype, dominant and recessive characteristics and homozygous and heterozygous individuals.

6 The need for transport

a. Plant transport systems

i. Water is required for transporting materials and for photosynthesis.

ii. Structures and processes involved in water movement to include root hairs, guard cells, stomata, epidermis, mesophyll cells and transpiration.
Water and minerals are transported up through the stem in xylem. Xylem cells are lignified.

iii. Sugar is transported up and down the plant in living phloem cells.

b. Animal transport and exchange systems

i. In mammals, nutrients, oxygen and carbon dioxide are transported in the blood.

ii. Pathway of blood through heat, lungs and body. Heart structure to include right and left atria and ventricles. Blood vessels to include aorta, vena cava, pulmonary arteries and veins and coronary arteries.

iii. Arteries have thick, muscular walls, a narrow central channel and carry blood under high pressure. Veins carry blood under low pressure, have thinner walls and a wide channel. Veins contain valves to prevent backflow of blood. Capillaries form networks at organs and tissues, and are thin walled and have a large surface area, allowing exchange of materials.

iv. Red blood cells contain haemoglobin and are specialised to carry oxygen.

v. Rings of cartilage keep airways open. Oxygen and carbon dioxide are exchanged in the alveoli. Alveoli have a large surface area, a good blood supply and thin walls to allow diffusion of gases.
Mucus traps dirt and microorganisms and cilia moves this up and out of the lungs.

vi. Food is moved through the digestive system by peristalsis. Villi in the small intestine are thin walled, have a large surface area and a good blood supply to aid absorption of glucose and amino acids. The lacteals transport the products of fat digestion.

7 Effects of lifestyle choices on animal transport and exchange systems

Life on Earth

1 Biodiversity and the distribution of life

a. Biotic, abiotic and human influences are all factors that affect biodiversity in an ecosystem.

b. Grazing and predation are biotic factors; pH and temperature are abiotic factors.

c. Biomes are the various regions of our planet as distinguished by their similar climate, fauna and flora.
Global distribution of biomes can be influenced by temperature and rainfall.

d. An ecosystem consists of all the organisms living in a particular area and the non-living components with which the organisms interact.

e. A niche is the role that an organism plays within a community. It includes the use it makes of the resources in its ecosystem and its interactions with other organisms in the community including competition, parasitism, predation, light, temperature and nutrient availability.

2 Energy in ecosystems

a. At each level in a food chain 90% of energy is lost as heat, movement or undigested materials.
b. Definitions and comparison of pyramids of biomass, energy and numbers.
c. Nitrogen in ecosystems
   Animal and plant proteins are produced from nitrates. The roles of nitrifying, denitrifying, root nodule and free-fixing soil bacteria.
   Decomposers convert proteins and nitrogenous wastes to ammonium and nitrate.
d. Competition in ecosystems
   Interspecific competition is when individuals of different species compete for the same resource in an ecosystem.
   Intraspecific competition is when individuals of the same species compete for exactly the same resources.

3 Sampling techniques and measurement of abiotic and biotic factors

a. plants and animals using quantitative techniques including quadrats and pitfall traps.
b. Evaluation of limitations and sources of error in pitfall traps and quadrats.
c. Measuring abiotic factors including light intensity, temperature, pH and soil moisture.

4 Adaptation, natural selection and the evolution of species

a. A mutation is a random change to genetic material. Mutations may be neutral, confer an advantage or a disadvantage.
   Mutations are spontaneous and are the only source of new alleles.
   Environmental factors, such as radiation and chemicals, can increase rate of mutation.
b. Variation within a population makes it possible for a population to evolve over time in response to changing environmental conditions.
c. Natural selection/survival of the fittest occurs when more offspring are produced than the environment can sustain. Only the best adapted individuals survive to reproduce, passing on the genes that confer the selective advantage.
d. Speciation occurs after a population becomes isolated and natural selection follows a different path due to different conditions/selection pressures.

5 Human impact on the environment

a. Increasing human population requires an increased food yield.
b. Fertilisers can leach into fresh water, causing algal blooms. This leads to a reduction in oxygen levels.
c. Pesticides sprayed onto crops can accumulate in the bodies of organisms over time. As they are passed along food chains, toxicity increases and can reach fatal levels.
d. Indicator species are species that by their presence or absence indicate environmental quality/levels of pollution.
e. Biological control and GM crops may be alternatives to mitigate the effects of intensive farming on the environment.

Administrative information

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Superclass: to be advised

History of changes to Course Assessment Specification

Course details	Version	Description of change	Authorised by	Date