Higher
Course Assessment
Specification

Higher Environmental Science Course Assessment Specification (C726 76)

Valid from August 2014

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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: Higher Environmental Science

SCQF level: 6 (24 SCQF credit points)

Course code: C726 76

Course assessment code: X726 76

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	100 marks
Component 2 — assignment	20 marks
Total marks	**120 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 assessment 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 environmental science
- 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 environmental science 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 one Section. 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 environmental science by making statements, describing information, providing explanations and integrating knowledge
- applying environmental science knowledge to new situations, analysing information and solving problems
- planning and designing experiments/practical investigations to test given hypotheses or to illustrate particular effects including safety measures
- selecting information from a variety of sources
- presenting information appropriately in a variety of forms
- evaluating information to solve problems, make decisions and resolve conflicts
- processing information (using calculations and units, where appropriate)
- making predictions and generalisations from evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- evaluating experiments/practical investigations and suggesting improvements

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 100 marks.

The question paper will have one Section, which contains restricted and extended response questions.

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 and problem solving skills.

Component 2 — assignment

This assignment requires learners to apply skills, knowledge and understanding to investigate a relevant topic in environmental science. The topic should draw on one or more of the key areas of the Course, and should be chosen with guidance from the assessor.

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

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

- applying environmental science knowledge to new situations, analysing information and solving problems
- selecting information and presenting information appropriately in a variety of forms
- processing the information (using calculations and units, where appropriate)
- drawing valid conclusions and giving explanations supported by evidence/justification
- communicating findings/information effectively

The assignment will have 20 marks out of a total of 120 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 knowledge and understanding related to the topic chosen.

The assignment offers challenge by requiring skills, knowledge and understanding to be applied in a context that is one or more of the following:

- unfamiliar
- familiar but investigated in greater depth
- integrates a number of familiar contexts

This assignment has two stages:

- a research stage
- a communication stage

In the course of their assignment, learners are required to:

- choose a relevant topic in environmental science (the assessor must review the appropriateness of the topic chosen)
- state appropriate aim(s)
- research the topic by selecting relevant data/information
- process and present relevant data/information
- analyse data/information
- state conclusions
- evaluate their investigation
- explain the underlying environmental science of the topic researched
- present the findings of the research in a report

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 and 30 minutes.

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

The research stage will be conducted under some supervision and control.

The communication stage will be conducted under a high degree of supervision.

SQA will provide Assignment General assessment information and Assignment Assessment task documents. SQA will specify the material to be taken into the communication stage of the assignment.

The production of the report will be carried out:

- 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 Higher Environmental Science 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 environmental science by making statements, describing information, providing explanations and integrating knowledge
- applying environmental science knowledge to new situations, analysing information and solving problems
- planning and designing experiments/practical investigations to test given hypotheses or to illustrate particular effects including safety measures
- carrying out experiments/practical investigation safely, recording detailed observations and collecting data
- selecting information from a variety of sources
- presenting information appropriately in a variety of forms
- evaluating information to solve problems, make decisions and resolve conflicts
- processing information (using calculations and units, where appropriate)
- making predictions and generalisations from evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- evaluating experiments/practical investigations and suggesting improvements
- communicating findings/information effectively

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

The following table specifies the mandatory knowledge for the Higher Environmental Science Course.

Living Environment
1 Investigating ecosystems and biodiversity a. Ecological terms to include habitat community, biotic, abiotic, biomass, biodiversity, species, niche, population, adaptation and competition (interspecific and intraspecific), edaphic, with named examples. b. Factors which influence biodiversity in the context of one aquatic and one terrestrial ecosystem of international importance. c. Sampling plants and animals using qualitative **and** quantitative techniques. ♦ Sampling techniques to include terrestrial and aquatic examples: transects, quadrats, nets (sweep, mist, dip), traps (mammal, moth, camera traps), bat detectors, electro-fishing, Tullgren and Baermann funnels. ♦ Qualitative: provide species lists. ♦ Quantitative: provide information about numbers and densities (cover/distribution, abundance/frequency measures). ♦ Importance of randomisation and statistical analysis in sampling, including reliability and validity of results.

d. Measuring related abiotic factors and their effects on the frequency and distribution of organisms in the context of one aquatic and one terrestrial ecosystem. Abiotic factors to include:
   - ♦ Aquatic: water flow rate, oxygen concentration, water pH, salinity, tidal effects.
   - ♦ Terrestrial: temperature, light intensity, soil moisture, soil pH, humidity, wind velocity and direction, precipitation, slope.

e. The need for accurate identification of flora and fauna.
f. Use and construction of paired statement keys (to identify at least five species).

2 Interdependence

a. Population dynamics in food webs
   Terms to include stability in populations, carrying capacity, mutualism, parasitism, commensalism, density-dependent and density-independent factors with named examples.
b. Energy conversion, transfer and loss in food chains and webs:
   - ♦ photosynthesis and respiration as essential energy converting processes
   - ♦ gross and net productivity; ecological efficiency in food chains and food webs
   - ♦ endotherms and ectotherms; impact on length of food chains

c. The effects of biotic factors to include predator-prey cycles, grazing, inter-specific and intra-specific competition.
d. Primary and Secondary succession. The sequence of seral succession from primary colonisers to climax community. Influence of climatic and edaphic factors on succession.
e. Human impact on the process of succession. Plagioclimax community Examples to include heather moors and chalk grassland.

3 Human influences on biodiversity

a. Human activities, in Scotland, through the Holocene period, which have affected ecosystems, from a positive and negative view-point. To include habitat destruction, species reduction and increase, changes in biodiversity and extinction through deforestation, afforestation, grazing, hunting, Agricultural and Industrial Revolutions, wars, introduction of non-native species.
b. Development of intensive agriculture: larger fields, fertilisers, pesticides, drainage of wetland ecosystems and its impact on biodiversity. Effects to include eutrophication, bioaccumulation and biomagnification.
c. Responses to eutrophication, bioaccumulation and biomagnification to include reduced use of fertilisers and pesticides, organic farming, specialised schemes and education to promote protection of ecosystems.
d. Impacts on biodiversity of urbanisation to include changes in land use, recreational use of land and water, including construction of buildings and transport routes. Environmental assessment (EIA and SEA).
e. Formation of acid rain and the minimisation of its impacts on biodiversity.
f. The impact of sewage (raw and treated) on freshwater ecosystems including biological oxygen demand.
g. The importance of indicator species to include fresh water invertebrates (stonefly larvae and blood worms) and lichens.
h. Impact of climate change on biodiversity and species distribution.
i. The impacts of non-native species and methods to minimise these impacts. Impacts to include loss of native species through competition, hybridisation

with native species. Examples to include grey squirrel, sika deer and Rhododendron ponticum.

j. Reintroduction to Scotland of nationally extinct species, both current (sea eagle, beaver) and potential (wolf, lynx).

k. The need for legislation and policies to include current conservation and land/marine management policies. Key role of SSSIs. Role of statutory agencies (SNH, SEPA, FCS, MS).

Earth's Resources

The Overview of Earth systems and their interactions underpins the key areas in this Unit.

- Geosphere, hydrosphere, biosphere and atmosphere as Earth systems.
- Interactions, including the cycles, among the geosphere, hydrosphere, pedosphere, biosphere and atmosphere.
- Definition and classification of physical, biological, renewable and non-renewable resources.

1 Geosphere

a. Mechanisms of destructive and construction plate boundaries, and their role in the formation of named mineral deposits, including major mineral ores.

b. Plate movements (past and present) and the effect on resource distribution.

c. Aluminium: formation, discovery, extraction, processing of aluminium ore and uses of aluminium.

d. Clay and baryite: formation, discovery, extraction and uses of baryite (oil drilling and biomedical imaging) and clay (firebricks, bricks, tunnel and ditch support, ceramics, fuller's earth, cat litter, fining beer).

e. Shale oil and shale gas formation, discovery, extraction, processing and use including the wider social issues relating to these.

f. Sources of the Earth's internal heat, heat flow and geothermal power.

g. Appraisal of the role of named legislation, and policies and initiatives for the protection, promotion and sustainable use of the geosphere; policies to include SSSI, Fossil Code, and Geoparks. Intrinsic value of the Earth's surface, to include tourism, recreation, quality of life measures.

2 Hydrosphere

a. Water movement within the hydrological cycle to include:
   - Hydrological cycle: states (solid ice, liquid water, water vapour), movement processes (evaporation, condensation, precipitation, transpiration, sublimination), and storage (both surface and subterranean).
   - Interpretation of hydrographs.

b. Factors influencing oceanic circulation.

c. Changes in sea-level relative to land, including isostatic and eustatic change.

d. Problems arising from unequal distribution of water resources — areas of surplus and deficit.

e. Water transfer schemes — the movement of water from surplus to deficit areas.

f. Uses of water for paper making, brewing, whisky distilling, irrigation.

g. The hydrogen economy to include source, production and potential for use.

3 Biosphere

a. Soils: inputs and processes involved in formation, structure and composition of podzols and brown earths, to include soil profiles. Commercial use related

to podzol and brown earth soil types.

b. Seaweed. Resources obtained from seaweed including alginates. Uses include in food processing, fertilisers and in cosmetics.
c. Barley. Uses including whisky distilling, brewing and food processing.
- ♦ Factors that impact on barley production: edaphic (soil), abiotic and anthropogenic.
- ♦ Uses to include whisky distilling and brewing (including importance of nitrogen content to both), and food processing.

d. Processed biofuels including biodiesel, bio-crude oil biomethanol and bioethanol. Advantages and disadvantages of using processed biofuels.

4 Atmosphere

a. The Structure and composition of the Earth's atmosphere.
   - ♦ Structure: troposphere, stratosphere, mesosphere, thermosphere, exosphere.
   - ♦ Composition: carbon dioxide, methane, water vapour, ozone, nitrogen, oxygen.
   - ♦ Effect of albedo.

b. Atmospheric circulation including heat and moisture transfer.
   - ♦ Global energy budget
   - ♦ Tri-cellular model
   - ♦ Rossby waves
   - ♦ Surface wind patterns
   - ♦ Coriolis effect

c. Climate variability. Natural and anthropogenic causes. Climate zones/biomes.
d. Wave power. Advantages and disadvantages.

Sustainability

Sustainability and sustainable development within both more economically developed countries (MEDC EMDC) and less economically developed countries (LEDCELDC) underpins the key areas in this Unit.

Sustainable development is development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report/Our Common Future (UN).

In this Unit, ecological and sustainable practices should be considered and compared with industrial and agricultural perspectives. This Unit can be considered in conjunction with other Units of Environmental Science.

1 Food

a. Increasing demand for global food supplies due to increasing population and changing consumer demands, changes brought about by development and the effect on food security.
b. Global strategies to increase food production:
   - ♦ Land-based food production systems, to include mechanisation, use of fossil fuels in food production, agrochemicals (fertilisers, pesticides), irrigation, land management (crop rotation, drainage, hedgerow removal, cultivation of marginal land, conservation practices, diversification), genetic engineering, GM crops, high yield varieties, selective breeding, hydroponics.

- ♦ Aquatic food production systems to include aquaculture (high density cages, pesticides, selective breeding, GM crops, hormone use) and marine fishing.
- ♦ Appraisal of these strategies, including their social, economic and environmental impacts.

c. Government role in food production:
- ♦ The EU role in farming and fishing legislation (CAP and CFP).
- ♦ The advisory role of the UN in relation to organic farming, biofuel and diversification.
- ♦ Appraisal of current UK/Scottish policies and legislation, including consideration of the reason(s) underpinning the policies and impacts of the policies.

2 Water

a. Increasing global water demand due to population pressure, agriculture, industry and the demands from development.
b. Sustainable management of water resources, to include reservoirs and groundwater storage; water conservation in domestic, industrial and agricultural usage; desalination (including reasons for desalination, and use of distillation and membrane filtration methods); and irrigation, including drip irrigation and drought resistant crops.
c. Global attempts to increase access to clean water, and methods to improve quality of water supply to include filtration, purification and disinfection to prevent spread of water-borne diseases.
d. Sewage treatment to include screening, settling, filter beds, anaerobic digestion, disposal or use of resulting materials.
e. The EU role in water quality and the advisory role of the UN and the input of non-governmental organisations (NGO) including appraisal of named examples.

3 Energy

a. Increasing global energy demand due to population increase, consumerism, changes in demand from different sectors (transportation, domestic, agriculture, industry) and from different stages of development (eg MEDC EMDC and LEDCELDC).
b. Build-up of anthropogenic greenhouse gases and the enhanced greenhouse effect, the work of the IPCC.
c. Environmental, social and economic impacts of climate change including sea level rise, impact on ocean currents, desertification, crop failures and famine, changing weather patterns and global dimming.
d. Appraisal of sustainable strategies to reduce greenhouse gas emissions including energy conservation, energy taxation, energy efficient appliances and engines.
e. Nuclear power generation, including fission and nuclear waste and advantages and disadvantages of nuclear power generation compared with those of fossil fuels and renewable sources. Disposal, storage and possible long term effects of nuclear waste.
f. Appraisal of named national and international policies and legislation to minimise greenhouse gas emissions from energy production.

4 Waste management

a. Increased global waste production due to increased population and consumer demands and globalisation of supply chains and obsolescence of

technological goods.

b. Waste management, to include:
   - ♦ minimisation: improved quality control and process monitoring, food use-by dates and impact on food waste, education
   - ♦ reuse and preparation for reuse
   - ♦ recycling: advantages and disadvantages
   - ♦ energy recovery
   - ♦ disposal: advantages and disadvantages of incineration, landfill and composting

c. Life cycle analysis to examine the energy, materials and transport involved in making, using and disposal of a resource appraisal of circular and linear economic models.

d. Appraisal of named national and international policies and legislation to manage waste.

Administrative information

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History of changes to Course Assessment Specification

Course details	Version	Description of change	Authorised by	Date
	2.0	Page 2 – the number of marks awarded for the assignment has changed. Pages 4 and 5 – the descriptions of the skills to be assessed have been rewritten to better explain what is required. Page 6 – Conducting the assessment: this has been rewritten to clarify how stages will be assessed. Suggested timings for each stage have been removed. Page 7 –the details of the skills to be assessed have been rewritten for clarity Page 7 onwards – Further mandatory knowledge: these tables have been substantially revised to aid understanding	Qualifications Development Manager	April 2014
	2.1	All key areas have been updated to include more clarification and detail of the level of demand required for the mandatory content. There is no additional mandatory content.	Qualifications Development Manager	June 2014
	2.2	Minor typographical errors amended — biomagnification, deforestation.	Qualifications Manager	April 2015