National 5 Course Specification

National 5 Environmental Science

Course code:	C826 75
Course assessment code:	X826 75
SCQF:	level 5 (24 SCQF credit points)
Valid from:	session 2020-21

The course specification provides detailed information about the course and course assessment to ensure consistent and transparent assessment year on year. It describes the structure of the course and the course assessment in terms of the skills, knowledge and understanding that are assessed.

This document is for teachers and lecturers and contains all the mandatory information you need to deliver the course.

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Contents

Course overview

The course consists of 24 SCQF credit points which includes time for preparation for course assessment. The notional length of time for a candidate to complete the course is 160 hours.

The course assessment has two components.

Component	Marks	Scaled mark	Duration
Component 1: question paper	100	n/a	2 hours and 30 minutes
Component 2: assignment	20	25	8 hours, of which a maximum of 1 hour and 30 minutes is allowed for the report stage — see course assessment section

Recommended entry	Progression
Entry to this course is at the discretion of the centre. Candidates should have achieved the fourth curriculum level or the National 4 Environmental Science course or equivalent qualifications and/or experience prior to starting this course. Candidates may also progress from relevant biology, chemistry, physics, science or geography courses.	♦ other qualifications in environmental science or related areas ♦ further study, employment or training

Conditions of award

The grade awarded is based on the total marks achieved across all course assessment components.

Course rationale

National Courses reflect Curriculum for Excellence values, purposes and principles. They offer flexibility, provide more time for learning, more focus on skills and applying learning, and scope for personalisation and choice.

Every course provides opportunities for candidates to develop breadth, challenge and application. The focus and balance of assessment is tailored to each subject area.

Environmental science is an interdisciplinary subject which draws from the sciences and social sciences. Environmental scientists are involved in tackling issues such as global climate change, pollution, use of land and water resources, and changes in wildlife habitats.

Environmental science courses encourage the development of skills and resourcefulness which lead to becoming a confident individual. Successful candidates in environmental science think creatively, analyse and solve problems. Studying relevant areas of environmental science such as the living environment, the Earth's resources and sustainability produces responsible citizens.

The National 5 Environmental Science course is practical and experiential and develops scientific awareness of environmental issues. It involves an understanding of scientific principles, economic influences and political action.

The course allows candidates to understand and investigate the world in an engaging and enjoyable way. It develops candidates' abilities to think analytically, creatively and independently, and to make reasoned evaluations. The course provides opportunities for candidates to acquire and apply knowledge, to evaluate environmental and scientific issues, to consider risk, and to make informed decisions. This can lead to candidates developing an informed and ethical view of topical issues. Candidates develop skills in communication, collaborative working and leadership, and apply critical thinking in new and unfamiliar contexts to solve problems.

Purpose and aims

The purpose of the course is to develop candidates' curiosity, interest and enthusiasm for environmental science in a range of contexts. The skills of scientific inquiry are integrated and developed throughout the course, as well as investigative and experimental skills.

The course develops a scientific understanding of environmental issues. It provides a broad and up-to-date selection of ideas relevant to the role of environmental science in society. This develops an understanding of environmental issues and possible solutions to preventing or reversing environmental degradation, and of sustainable practices.

The course provides a range of opportunities for candidates to investigate key areas of the living environment such as biodiversity and interdependence. Through the Earth's systems, candidates investigate access to and use of resources associated with the atmosphere, hydrosphere, geosphere and biosphere. Sustainability and sustainable development are explored through food, water and energy security, as well as investigating issues relating to waste generation and its management.

The course has a strong interdisciplinary nature and aims to develop skills, knowledge and understanding in relevant areas of science and social science. It provides opportunities for candidates to develop scientific literacy skills. In addition, candidates recognise the impact environmental science makes on their lives, on the lives of others, on the environment, and on society.

Due to its interdisciplinary nature, candidates gain additional benefit from studying environmental science along with other science subjects and/or geography, as this enhances the candidates' skills, knowledge and understanding. The course allows flexibility and personalisation by allowing choice of topic for the assignment.

The aims of the course are for candidates to:

- develop and apply knowledge and understanding of environmental science
- develop an understanding of environmental science's role in scientific issues and relevant applications of environmental science, including the impact these could make in society and the environment
- develop scientific inquiry and investigative skills
- develop scientific analytical thinking skills in an environmental science context
- develop the skills to use technology, equipment and materials, safely, in practical scientific activities
- develop planning skills
- develop problem-solving skills in an environmental science context
- develop practical fieldwork skills in an environmental science context
- use and understand scientific literacy, in everyday contexts, to communicate ideas and issues and to make scientifically informed choices
- develop the knowledge and skills for more advanced learning in environmental science
- develop skills of independent working

This course enables candidates to make their own decisions on issues within a modern society where the body of scientific knowledge and its applications and implications are ever developing.

Who is this course for?

The course is suitable for learners who have experienced learning across the sciences experiences and outcomes. It may be suitable for those wishing to study environmental science for the first time.

This course has a skills-based approach to learning. It takes account of the needs of all learners and provides sufficient flexibility to enable learners to achieve in different ways.

Course content

Candidates gain an understanding of environmental science through a variety of approaches, including practical activities. They research topics, apply scientific skills and communicate information related to their findings, which develops skills of scientific literacy.

The course content includes the following areas of environmental science:

Living environment
The key areas covered are: investigating ecosystems and biodiversity; interdependence; human influences on biodiversity.

Earth's resources
The key areas covered are: an overview of Earth systems and their interactions; the geosphere; the hydrosphere; the biosphere; the atmosphere.

Sustainability
The key areas covered are: an introduction to sustainability; food; water; energy; waste management.

Skills, knowledge and understanding

Skills, knowledge and understanding for the course

The following provides a broad overview of the subject skills, knowledge and understanding developed in the course:

- demonstrating knowledge and understanding of environmental science by making statements, describing information, providing explanations and integrating knowledge
- applying knowledge of environmental science to new situations, interpreting information and solving problems
- planning, designing, and safely carrying out experimental/fieldwork investigations 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 practical experimental/fieldwork investigations
- communicating findings/information

Skills, knowledge and understanding for the course assessment

The following provides details of skills, knowledge and understanding sampled in the course assessment.

Living environment

1 Investigating ecosystems and biodiversity

a Definitions:

- habitat — the place where an organism lives
- community — all the organisms that live together in an ecosystem
- population — a number of organisms of one species in an ecosystem
- ecosystem — a natural biological unit made up of living and non-living parts, ie the community and the habitat
- biodiversity — the variety that exists among living things
- species — a group of organisms that can interbreed to produce fertile offspring
- biotic — a living feature of an ecosystem, such as food supply, disease, predation
- abiotic — a non-living feature of an ecosystem, such as light intensity, precipitation, temperature, wind speed, wind direction
- adaptation — any feature that makes an organism well suited to living in its environment
- competition — a negative interaction that occurs between organisms whenever there is demand for a limited resource

b Biodiversity in the context of one aquatic and one terrestrial ecosystem.

c Quantitative techniques for sampling plants and animals:

- quadrat
- transect (line)
- nets
- traps (pitfall, camera, mammal)
- capture–mark–recapture

d Techniques to measure abiotic factors:

- aquatic — water flow rate, oxygen concentration, water pH, and water temperature
- terrestrial — temperature, light intensity, soil moisture, soil pH, wind velocity, wind direction, and precipitation

e Limitations of quantitative techniques and potential sources of error:

- quantitative techniques provide information about frequency and distribution
- the larger the sample the more reliable the results will be
- counts of individuals rely on accurate identification

- all measurements have a potential to introduce error: equipment should be calibrated and used appropriately.

The importance of random sampling and reliability of results:

- random sampling: every individual in a population has an equal chance of being selected
- reliability of results: the extent to which an experiment, test or other measuring procedure yields the same results on repeated trials

f The effect of abiotic factors on the distribution of organisms.

g Identification of organisms through construction and use of paired-statement keys.

2 Interdependence

a Definitions:

- carnivore — an animal that only eats other animal material
- herbivore — an animal that only eats plant material
- omnivore — an animal that eats both plant and animal material
- detritivore — an animal that feeds on dead organic matter, eg wood louse, earthworm, maggot
- decomposer — bacteria and fungi that feed on dead organic matter at microscopic level
- producer — an organism that can produce its own food; usually a green plant that produces its own food via photosynthesis
- primary consumer — a herbivore that eats the producer in a food chain
- secondary consumer — an animal that eats the primary consumer in a food chain
- tertiary consumer — an animal that eats the secondary consumer in a food chain
- niche — the role played by a species within a community: where it lives, what it eats and what eats it

b Food webs, in the context of one aquatic and one terrestrial ecosystem.

c Interdependence between plants and animals.

Simple word equations for photosynthesis and respiration.

d Energy flow through food webs.

e Energy loss through movement, heat and undigested material.

f Factors affecting food webs: predation, disease, competition, natural and human impacts.

Living environment

g Carbon cycle:

- The role of the carbon cycle in recycling nutrients.
- Processes in the biological carbon cycle: photosynthesis, respiration, feeding, decomposition, formation and combustion of fossil fuels.
- Organisms involved in the carbon cycle: the role of detritivores and decomposers.

h Nitrogen cycle:

- The role of the nitrogen cycle in recycling nutrients.
- Processes: fixation (by soil bacteria, lightning), death/decay (decomposition by fungi and bacteria), nitrification and denitrification, nitrate absorption by plants, feeding by animals.
- Organisms involved in the nitrogen cycle: the roles of bacteria in fixation (free-living bacteria and bacteria in root nodules on legumes), decomposition, nitrifying, and denitrifying.

3 Human influences on biodiversity

a Definitions:

- non-native species — a species introduced through human action (accidental or deliberate) outside its native distribution
- invasive non-native species (INNS) — any non-native animal or plant that has the ability to spread and cause damage to the environment, the economy, our health or the way we live
- indicator species — the presence, absence or abundance of certain living organisms that show an environment is affected by a particular set of environmental conditions

b Human activities which have a positive and/or negative effect on ecosystems, with a focus on species reduction or increase, extinction and loss of biodiversity.

c The role of a named indicator species in environmental monitoring.

d The impact of a named INNS on ecosystems.

e Conflicts between land and/or water-based activities.
At least two stakeholders using a single resource, with potential solution/compromise for shared use.

f Relevant current national organisations:

- the role of Scottish Environmental Protection Agency (SEPA) as an environmental regulator
- the role of NatureScot (NS) as an environmental educator and advisor
- designation and purpose of Sites of Special Scientific Interest (SSSI) in Scotland

Earth's resources

1 Overview of Earth systems and their interactions

a Identification of the main Earth systems: geosphere, hydrosphere, atmosphere, and biosphere.

b Classification of resources into physical, biological, renewable and non-renewable.

2 Geosphere

a Definitions:

- weathering — the exposure and breaking down of rocks in situ at the Earth's surface over geological time due to interaction with the atmosphere
- transportation — the movement of rock fragments by water, wind, ice or gravity from the place where they were originally weathered
- erosion — the breaking down of rock fragments into smaller pieces and sediments due to collision with other rock fragments during transportation
- deposition — the settling out of rock fragments and sediments after transportation by water, wind, ice or gravity
- igneous — rock that forms through the cooling of molten rock (magma) to a solid form in the upper crust or on the surface of the Earth
- sedimentary — rock that is formed from weathered rock fragments and sediments that have been eroded, transported, deposited, compacted and cemented
- metamorphic — rock that has been subjected to heat and/or pressure, permanently altering the minerals or internal structure
- rock — a solid mass made of one or more minerals
- mineral — an element or chemical compound formed as a result of rock cycle processes
- ore — a naturally occurring solid material from which a metal or valuable mineral can be extracted profitably
- porosity — a measure of a rock's ability to hold fluid
- permeability — a measure of the amount of water allowed to pass through a rock

b Structure of the Earth
Core (inner and outer), mantle, and crust (oceanic and continental).

c Rock cycle processes:

- erosion
- weathering (physical, chemical, biological, link with soil formation)
- transportation
- deposition
- melting
- effects of heat and pressure
- formation of igneous (granite, basalt), sedimentary (sandstone, shale), and metamorphic (marble, slate) rocks

Earth's resources

d Relationship between rocks, minerals, and ores:

- rock — granite is mostly composed of quartz, biotite and feldspar minerals
- minerals — quartz (silica and oxygen), calcium carbonate (calcium, carbon and oxygen)
- ore — metallic iron can be economically extracted from iron ores

e Properties of rocks: porosity and permeability.

f Limestone:

- formation (formed in shallow tropical sea water as a result of calcium carbonate precipitating out)
- extraction (quarrying)
- processing (cutting, crushing)
- uses
- environmental impacts of extraction and/or processing

Uses of limestone: cement manufacture, construction, agriculture, iron and steel manufacture.

g Geological carbon cycle; the role of limestone and coal as carbon sinks; and chemical weathering (carbonic acid).

h Iron ore:

- formation (formed in sea water as a result of oxygen release by photosynthesising organisms; the oxygen combines with dissolved iron in the ocean to form iron oxide)
- extraction (opencast mining)
- processing (blast furnace)
- uses
- environmental impacts of extraction and/or processing

Processing: ore smelting in a blast furnace; inputs (iron ore, limestone, oxygen, coke) and outputs (pig iron, slag, carbon dioxide).

Uses of iron: steel manufactured products, reinforced concrete, cast iron and wrought iron products.

i Crude oil:

- formation (formed from the remains of small animals and plants that died and fell to the seafloor millions of years ago; compression and heating of these remains within the Earth's crust forms oil)
- extraction (drilling)
- processing (fractional distillation)

Earth's resources

- uses
- environmental impacts of extraction, processing and uses

Processing: fractional distillation (including role of temperature in formation of outputs), graduation in molecule size.

Uses: domestic and industrial fuels, electricity generation, petrol, diesel, fuel oil, plastics, tar, bitumen, lubricants, roofing felt, medicines, and cosmetics.

Environmental impacts of crude oil products.

3 Hydrosphere

a Definitions:

- evaporation — the process of turning from liquid into vapour or gas
- condensation — the process of a vapour or gas turning into a liquid
- precipitation — moisture that falls from the air to the ground (rain, snow, sleet, hail, drizzle, fog, mist)
- transpiration — the evaporation of water from plants' leaves, stems or flowers
- run-off — the precipitation that flows across the surface of the ground
- infiltration — the physical movement of water through soil (relative to the soil's porosity and permeability)
- percolation — the movement of water through soil by gravity and capillary forces
- throughflow — the horizontal flow of water within soil
- groundwater — water that occupies pore spaces in soil and bedrock
- groundwater flow — the movement of groundwater horizontally

b Water cycle: evaporation, condensation, precipitation, transpiration, run-off, infiltration, percolation, throughflow, groundwater flow, storage.

c Main stores of water: atmosphere, oceans, ice, freshwater (rivers, streams, springs), groundwater (soil moisture, rock pores and crevices), and aquifers.

d Uses of water: industrial, domestic, and agricultural.

e Issues arising from availability of water resources in Scotland and the rest of the British Isles: drought and flooding.

Role of SEPA in flood warning and water quality.

f Energy from water: hydro-electric, tidal, wave, energy changes involved (kinetic to electrical).

Earth's resources

g Requirements and considerations for siting hydro-electric and tidal power stations:

- ♦ hydro-electric power (HEP): steep gradient, high precipitation, narrow deep valley, impermeable geology, population density, proximity to National Grid, current land use
- ♦ tidal: narrow channel, large water volume, large tidal stream, population density, proximity to National Grid, current water use

4 Biosphere

a Definitions:

- ♦ biomass — the mass of living or recently living plants or animals
- ♦ biofuels — combustible biomass or fuels derived from biomass

b Oceanic and freshwater resources: economically important species of plants and animals.

c Terrestrial resources: economically important species of domesticated and hunted animals, agricultural crops, forestry (native and plantation).

d Energy from biological resources: biomass (wood, peat).

Process of fermentation in formation of biofuels: conditions required for formation of peat (acidic and anaerobic), and methane as the primary biogas.

5 Atmosphere

a Definition:

- ♦ natural greenhouse effect — the process by which radiation reflected from the Earth's surface is absorbed by gases in the atmosphere and prevented from escaping into space, thus keeping the Earth warmer than it would otherwise be

b Composition of the atmosphere (nitrogen, oxygen and carbon dioxide), and the importance of the 'natural' greenhouse effect.

c Energy from wind, including energy changes involved (kinetic to electrical).

d Requirements and considerations for siting wind farms: strong/steady wind flow, exposed site, population density, proximity to National Grid, current land/water use.

Sustainability

1 Introduction to sustainability

a Definitions:

- sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs
- sustainability is the relationship or balance between social, economic and environmental issues
- global citizenship is an awareness of the world as a global community and recognition of the rights and responsibilities of citizens within it

b Global citizenship: role of the United Nations sustainable development goals, education and personal responsibility.

2 Food

a Definitions:

- food miles — the distance food travels from the time of its production until it reaches the consumer
- carbon footprint — the mass of carbon dioxide emitted by any specific activity
- carbon neutral — no net release of carbon dioxide into the atmosphere
- carbon offsetting — compensating for emissions of carbon dioxide into the atmosphere with an equivalent reduction in carbon dioxide emissions elsewhere

b Impacts (social, economic, environmental) of an increasing global population on food supplies.

c Strategies in farming for a secure food supply: intensive farming, genetically modified (GM) crops, and agrochemicals (fertilisers and pesticides).

d Organic farming, including advantages and disadvantages.

e Strategies in freshwater and marine-based systems for a secure food supply: intensive fishing (trawling, dredging) and promotion of alternative species.

f Fish conservation approaches: marine conservation areas, zoning, and sustainable fishing methods (mesh size, net shape, days at sea, line fishing, hand diving).

g Environmental impact of food distribution: food miles, carbon footprint, carbon neutral, carbon offsetting.

Strategies to reduce carbon footprint.

Sustainability

3 Water

a Definition:

- wastewater — water that has been used in the home, in a business, or as part of an industrial process

b Impacts (social, economic, environmental) of an increasing global population on water supplies.

Clean water supplies in developing and developed countries.

c Issues arising from water use:

- industry — water pollution, effluents
- agriculture — water pollution and change in water levels as a consequence of water abstraction and irrigation
- domestic — gardening, washing, cooking, heating, sanitary, may lead to water shortages in times of drought and to water-use restrictions
- impacts on public health, contamination and pollution of water supplies, conservation, and tourism and recreation
- impact of wastewater, including untreated sewage, on aquatic ecosystems

d Sustainable approaches to water use: methods of water conservation in domestic, agricultural and industrial contexts.

e Role of SEPA in monitoring and enforcement.

4 Energy

a Definitions:

- enhanced greenhouse effect — the enhancement of the natural greenhouse effect through man-made emissions of greenhouse gases, trapping increasing quantities of heat
- climate change — a large-scale, long-term shift in Earth's weather patterns or average temperatures

b Impacts (social, economic, environmental) of an increasing global population on energy supplies.

c The 'enhanced' greenhouse effect.
Carbon dioxide, nitrous oxide and methane, and their sources.

d Renewable and non-renewable energy sources and issues arising from their use.

Sustainability

e Sustainable approaches to reduce greenhouse gas emissions in transport, industry, domestic and agricultural contexts.

f Impacts (social, economic and environmental) of climate change: habitat loss, reduction in biodiversity, changes in species distribution, rising sea levels leading to flooding, loss of agricultural land, and loss of business.

5 Waste management

a Definitions:

- reduce — to decrease the amount of waste produced
- reuse — to refill or find another use for a product without processing it other than cleaning
- recycle — to reprocess materials into new and useful products

b Increase in waste production as a result of an increasing global population and societal demands.

c Sustainable approaches to managing waste: reduce, reuse and recycle, and local initiatives to encourage these.

d Role of SEPA in waste management.

Apparatus and techniques

In addition to the key areas, candidates must have knowledge of the following pieces of apparatus and techniques. Where it is not possible to carry out a practical technique, candidates should be made aware of the purpose and methodology of the technique through teaching.

Apparatus

- beaker
- balance
- measuring cylinder
- dropper/pipette
- test tube
- stopwatch
- funnel
- crucible
- oven
- microscope
- choice chamber
- quadrat
- transect: tape measure or rope marked off in intervals
- metre stick

Apparatus and techniques

- nets: sweep, dip
- traps: pitfall, mammal, camera
- thermometer
- meters: light intensity, soil moisture, soil pH, water flow rate, oxygen concentration
- anemometer
- rain gauge
- floats
- test kits: soil pH, soil nitrate/nitrite
- ID cards/keys: plants, mammals, rocks

Techniques

- sampling plants and animals
- identification of species using paired-statement keys
- measuring abiotic factors
- assessing the distribution of a species by collecting discrete data via observation
- interpreting case study documentary evidence, including Ordnance Survey map content, sketch maps, photographic evidence, tabular data, and/or short passages of text — ability to read and provide grid references is not required

The course support notes provide a list of suggested learning activities. Choosing from the activities suggested in the course support notes, or carrying out any other appropriate activities, allows candidates to become familiar with the apparatus and techniques listed above. Where it is not possible to carry out a particular technique, other resources could be utilised.

Reporting experimental work/fieldwork

Candidates should be familiar with the following:

- setting an aim and/or hypothesis
- describing experimental/fieldwork procedures
- drawing labelled diagrams of experimental/fieldwork apparatus
- presenting data in tabular form, with appropriate headings and units of measurement
- presenting data in graphical form: bar graph, line graph or other graphical form appropriate to environmental science, with appropriate scales, labels, keys and units
- including a line of best fit (straight or curved) on a scatter graph, if appropriate, to represent the trend observed in experimental/fieldwork data
- comparing data sets
- drawing conclusions from the data, and relating them to the aim
- evaluating an experimental/fieldwork procedure and suggesting and justifying improvements

Calculations
Candidates should be familiar with the following methods of calculation: ♦ average: mean ♦ ratio ♦ percentage ♦ percentage increase/decrease ♦ calculations involving number substitution in formulae

Skills, knowledge and understanding included in the course are appropriate to the SCQF level of the course. The SCQF level descriptors give further information on characteristics and expected performance at each SCQF level (www.scqf.org.uk).

Skills for learning, skills for life and skills for work

This course helps candidates to develop broad, generic skills. These skills are based on SQA's Skills Framework: Skills for Learning, Skills for Life and Skills for Work and draw from the following main skills areas:

2 Numeracy

2.1 Number processes
2.2 Money, time and measurement
2.3 Information handling

4 Employability, enterprise and citizenship

4.6 Citizenship

5 Thinking skills

5.3 Applying
5.4 Analysing and evaluating

These skills must be built into the course where there are appropriate opportunities and the level should be appropriate to the level of the course.

Further information on building in skills for learning, skills for life and skills for work is given in the course support notes.

Course assessment

Course assessment is based on the information provided in this document.

The course assessment meets the key purposes and aims of the course by addressing:

- 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 experimental/fieldwork or theoretical contexts as appropriate

This enables candidates to:

- apply breadth and depth of skills, knowledge and understanding from across the course to answer questions in environmental science
- apply skills of scientific inquiry, using related knowledge, to carry out a meaningful and appropriately challenging task in environmental science and communicate findings

The course assessment has two components. The relationship between these two components is complementary, to ensure full coverage of the knowledge and skills of the course.

Course assessment structure: question paper

Question paper 100 marks

The purpose of the question paper is to assess breadth, challenge and application of skills, knowledge and understanding from across the course.

The question paper samples knowledge, understanding and skills from across the course. It also assesses the application or extension of knowledge and/or skills in unfamiliar situations, practical and theoretical contexts.

The question paper gives candidates an opportunity to demonstrate the following skills, knowledge and understanding:

- demonstrating knowledge and understanding of environmental science by making statements, describing information, providing explanations and integrating knowledge
- applying knowledge of environmental science to new situations, interpreting information and solving problems
- planning and/or designing experimental/fieldwork investigations 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 experimental/fieldwork investigations

The skills may be assessed in the context of any of the key areas of the course and in any section of the question paper. Overall, marks are evenly distributed across each of the three areas:

- living environment
- Earth's resources
- sustainability

The question paper has a total of 100 marks and is worth 80% of the overall marks for the course assessment.

The question paper has three sections:

Section 1
Section 1 consists of restricted response questions totalling 66 marks. This section samples knowledge and understanding and a selection of skills by presenting candidates with appropriately challenging context-based questions, broken down into sub-parts. There may be integration of key areas and skills from different areas of the course.

Section 2
Section 2 contains a case study, with 20 marks allocated for restricted response questions on related applications of environmental science. This section samples knowledge and understanding plus a selection of skills, and there may be integration of key areas and skills from different areas of the course.

All data and information relevant to the case study is provided in a separate supplementary booklet.

Section 3
Section 3 has a total of 14 marks. It has:

- one pair of structured extended-response questions with candidates selecting and answering one of these
- one pair of unstructured extended-response questions with candidates selecting and answering one of these

Each extended-response question has a mark allocation of 7 marks.

The majority (approximately 70%) of the marks are awarded for demonstrating and applying knowledge and understanding. The other marks (approximately 30%) are awarded for applying scientific inquiry, analytical thinking, problem-solving skills and the impacts of applications of environmental science on society and the environment.

Setting, conducting and marking the question paper

The question paper is set and marked by SQA, and conducted in centres under conditions specified for external examinations by SQA. The question paper is 2 hours and 30 minutes in duration.

Specimen question papers for National 5 courses are published on SQA's website. These illustrate the standard, structure and requirements of the question papers candidates sit. The specimen papers also include marking instructions.

Course assessment structure: assignment

Assignment 20 marks

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

This assignment allows assessment of skills, which cannot be assessed through the question paper, for example, the handling and processing of data gathered as a result of experimental/fieldwork and research skills.

Candidates apply skills, knowledge and understanding by carrying out an experiment or fieldwork procedure and investigating a topic relevant to 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 teacher/lecturer. It should be sufficiently open and flexible to allow for personalisation and choice.

Assignment overview

The assignment gives candidates an opportunity to demonstrate skills, knowledge and understanding by:

- applying knowledge of environmental science to new situations, interpreting information and solving problems
- planning, designing and safely carrying out experimental/fieldwork investigations 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 the 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 experimental/fieldwork investigations
- communicating findings/information

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

Candidates will research and report on a topic that allows them to apply skills and knowledge in environmental science at a level appropriate to National 5.

The topic must be chosen with guidance from the teacher/lecturer and must involve experimental/fieldwork.

The assignment has two stages:

- research
- report

The research stage must involve an experiment or fieldwork that allows measurements or counts to be made. Candidates must also gather data from the internet, books, journals and/or maps to compare against their experimental/fieldwork results. The candidates' research may also involve gathering extracts from internet/literature sources to support their account of the underlying environmental science.

Candidates must produce a report on their research.

Assessment should take place when candidates are ready to be assessed. It is not advisable to undertake the assignment too early, as it is important that candidates are adequately prepared in the skills needed to undertake all parts of the assignment.

Setting, conducting and marking the assignment

Setting

The assignment is:

- set by centres within SQA guidelines
- set at a time appropriate to the candidates' needs
- set within teaching and learning and includes experimental/fieldwork at a level appropriate to National 5

Conducting

The assignment is:

- an individually produced piece of work from each candidate
- started at an appropriate point in the course
- conducted under controlled conditions

Marking

The report is submitted to SQA for external marking.

All marking is quality assured by SQA.

Assessment conditions

Controlled assessment is designed to:

- ensure that all candidates spend approximately the same amount of time on their assignments
- prevent third parties from providing inappropriate levels of guidance and input
- mitigate concerns about plagiarism and improve the reliability and validity of SQA awards

- allow centres a reasonable degree of freedom and control
- allow candidates to produce an original piece of work

Time

It is recommended that no more than 8 hours is spent on the **whole** assignment. This includes a maximum of 1 hour and 30 minutes which is allocated to the report stage.

Supervision, control and authentication

There are two levels of control.

Under a high degree of supervision and control	Under some supervision and control
♦ the use of resources is tightly prescribed ♦ all candidates are within direct sight of the supervisor throughout the session(s) ♦ display materials that might provide assistance are removed or covered ♦ there is no access to e-mail, the internet or mobile phones ♦ candidates complete their work independently ♦ interaction with other candidates does not occur ♦ no assistance of any description is provided	♦ candidates do not need to be directly supervised at all times ♦ the use of resources, including the internet, is not tightly prescribed ♦ the work an individual candidate submits for assessment is their own ♦ teachers and lecturers can provide reasonable assistance

The assignment has two stages.

Stage	Level of control
♦ research	conducted under some supervision and control
♦ report	conducted under a high degree of supervision and control

Detailed conditions for assessment are given in the assignment assessment task.

Resources

Please refer to the instructions for teachers and lecturers within the assignment assessment task.

It is not permitted at any stage to provide candidates with a template or model answers.

In the research stage:

- teachers/lecturers must ensure that a range of topics is available for candidates to choose from
- teachers/lecturers must minimise the number of candidates investigating the same topic within a class
  - teachers/lecturers must agree the choice of topic with the candidate
  - teachers/lecturers must provide advice on the suitability of the candidate's aim
  - teachers/lecturers can supply a basic list of instructions for the experimental/fieldwork procedure
  - candidates must undertake research using **only** websites, journals, books and maps
  - a wide list of URLs and/or a wide range of books and journals may be provided

Teachers/lecturers **must not**:

- provide an aim
- provide candidates with experimental/field work data
- provide candidates with a blank or pre-populated table for experimental/field work results
- provide candidates with feedback on their research

The only materials that **can** be used in the report stage are:

- the instructions for candidates, which must not have been altered
- the experimental/fieldwork method, if appropriate
- the candidate's raw experimental/fieldwork data, which may be tabulated; the table must not have additional blank or pre-populated columns for mean and derived values
- comparative data/information from the internet or literature, which must not include sample calculations
- a record of the source of the comparative data/information
- extract(s) from internet/literature source(s) to support the underlying environmental science, which must not include sample calculations

Candidates must not have access to a previously prepared draft of a report or any part of a report.

In addition, candidates must not have access to the assignment marking instructions during the report stage.

Candidates must not have access to the internet during the report stage.

Teachers and/or lecturers must not provide any form of feedback to a candidate on their report.

Following completion of the report stage candidates must not be given an opportunity to redraft their report.

Teachers and/or lecturers must not read the reports before they are submitted to SQA.

Reasonable assistance

Candidates must undertake the assessment independently. However, reasonable assistance may be provided prior to the formal assessment process taking place. The term 'reasonable assistance' is used to try to balance the need for support with the need to avoid giving too much assistance. If any candidates require more than what is deemed to be 'reasonable assistance', they may not be ready for assessment or it may be that they have been entered for the wrong level of qualification.

The assignment assessment task provides guidance on reasonable assistance.

Evidence to be gathered

The following candidate evidence is required for this assessment:

- a report

The same report cannot be submitted for more than one subject.

Volume

There is no word count.

Grading

A candidate's overall grade is determined by their performance across the course assessment. The course assessment is graded A–D on the basis of the total mark for all course assessment components.

Grade description for C

For the award of grade C, candidates will typically have demonstrated successful performance in relation to the skills, knowledge and understanding for the course.

Grade description for A

For the award of grade A, candidates will typically have demonstrated a consistently high level of performance in relation to the skills, knowledge and understanding for the course.

Equality and inclusion

This course is designed to be as fair and as accessible as possible with no unnecessary barriers to learning or assessment.

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

Further information

The following reference documents provide useful information and background.

- National 5 Environmental Science subject page
- Assessment arrangements web page
- Building the Curriculum 3–5
- Design Principles for National Courses
- Guide to Assessment
- SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work
- Coursework Authenticity: A Guide for Teachers and Lecturers
- Educational Research Reports
- SQA Guidelines on e-assessment for Schools
- SQA e-assessment web page
- SCQF website: framework, level descriptors and SCQF Handbook

Appendix 1: course support notes

Introduction

These support notes are not mandatory. They provide advice and guidance to teachers and lecturers on approaches to delivering the course. They should be read in conjunction with this course specification, the specimen question paper and assignment assessment task.

Environmental science is an inter-disciplinary subject which draws from the sciences and social sciences. Environmental scientists are involved in tackling issues such as global climate change, pollution, use of land and water resources, and changes in wildlife habitats. The course involves an understanding of scientific principles, economic influences, and political action.

Developing skills, knowledge and understanding

This section provides further advice and guidance about skills, knowledge and understanding that could be included in the course. Teachers and lecturers should refer to this course specification for the skills, knowledge and understanding for the course assessment. Course planners have considerable flexibility to select coherent contexts which will stimulate and challenge their candidates, offering both breadth and depth.

An investigative approach is encouraged in environmental science with candidates actively involved in developing their skills, knowledge and understanding. Learning and teaching should build on candidates' prior knowledge, skills and experience. A holistic approach should be adopted to aid candidates' understanding of the linkages between the Earth's systems and natural and man-made actions that can impact on the Earth's natural balance

Where appropriate, experimental/fieldwork procedures should give candidates the opportunity to select activities and/or carry out extended study. Investigative and experimental work is part of the scientific method of working and can fulfil a number of educational purposes.

Learning and teaching should offer opportunities for candidates to work collaboratively. Practical activities and investigative work can offer opportunities for group work, which should be encouraged. Group work approaches can be used to simulate real-life situations, share tasks and promote team-working skills.

Experimental and fieldwork procedures should include the use of technology and equipment that reflect current scientific use in environmental science. Fieldwork provides an opportunity for practical work, using first-hand experience of an ecosystem to develop knowledge, understanding and problem-solving. Techniques and equipment that candidates should be aware of are included in the mandatory content table in this course specification as **these may be assessed in the question paper**. Appropriate risk assessment must be undertaken.

In addition to programmed learning time, candidates would be expected to contribute their own time.

Effective partnership working can enhance the learning experience. Where appropriate, locally relevant contexts should be studied, with visits if possible. Guest speakers from industry, further and higher education could be invited to share their knowledge of environmental science.

Information and Communications Technology (ICT) makes a significant contribution to practical work in environmental science. Computer-interfacing equipment can detect changes in variables, allowing experimental results to be recorded over short periods of time and experiments to be completed in class time. Results can also be displayed in real-time which helps to improve understanding. Data-logging equipment and video cameras can be set up to record data and make observations over periods of time longer than a class lesson which can be subsequently downloaded and viewed for analysis.

Assessment should be integral to, and improve, learning and teaching. The approach should involve candidates and provide supportive feedback. Self- and peer-assessment techniques should be encouraged, wherever appropriate. Assessment information can be used to set learning targets and next steps.

Approaches to learning and teaching

Teaching should involve a range of approaches to develop knowledge and understanding and skills for learning, life and work. Learning should be experiential, active, challenging and enjoyable.

Teachers and lecturers should organise practical experiments and/or fieldwork activities. Some of these could be candidate-led. Teachers and lecturers should also use a variety of active learning approaches. These could include peer-teaching and -assessment, individual and group presentations, role-playing, and game-based learning.

Learning about Scotland and Scottish culture will enrich the learning experience and help candidates to develop the skills for learning, life and work they will need to prepare them for taking their place in a diverse, inclusive and participative Scotland and beyond. Where there are opportunities to contextualise approaches to learning and teaching to Scottish contexts, teachers and lecturers should consider this.

As part of learning and teaching and preparation for assessment, it is recommended that candidates carry out several investigations that meet the requirements of the assignment as stipulated in this course specification. This should help candidates develop the necessary skills and prepare them for subsequent assessment.

Suggestions for learning and teaching activities are detailed in the table overleaf. The first column is identical to the table of ‘Skills, knowledge and understanding for the course assessment’ in this course specification. The second column offers suggestions for activities and resources that could be used to enhance teaching and learning. Teachers and lecturers may also devise their own learning activities and there is scope to adopt a cross-area, holistic approach. All resources named were correct at the time of publication and may be subject to change.

Note: access to STEM resources requires teachers and lecturers to register for a free account.

Living environment	Suggested learning activities and resources
1 Investigating ecosystems and biodiversity	
a Definitions of ecological terms: ♦ habitat — the place where an organism lives ♦ community — all the organisms that live together in an ecosystem ♦ population — a number of organisms of one species in an ecosystem ♦ ecosystem — a natural biological unit made up of living and non-living parts, ie the community and the habitat ♦ biodiversity — the variety that exists among living things ♦ species — a group of organisms that can interbreed to produce fertile offspring ♦ biotic — a living feature of an ecosystem, such as food supply, disease, predation ♦ abiotic — a non-living feature of an ecosystem, such as light intensity, precipitation, temperature, wind speed, wind direction ♦ adaptation — any feature which makes an organism well suited to living in its environment ♦ competition — a negative interaction that occurs between organisms whenever there is demand for a limited resource	Candidates could keep a glossary of terms and definitions.

Living environment	Suggested learning activities and resources
1 Investigating ecosystems and biodiversity	
b Biodiversity in the context of one aquatic and one terrestrial ecosystem.	Investigate biodiversity in aquatic and terrestrial ecosystems. Organise field/site visit. Analysis of biodiversity data. Watch AV resources, eg on sea and freshwater lochs, deciduous and coniferous forest, heather moorland, machair, grassland, hedgerows. Resources available from: — Biodiversity Scotland — NatureScot — James Hutton Institute — European Environment Agency — Marine Scotland (including data access) — Forestry and Land Scotland — STEM
c Quantitative techniques for sampling plants and animals: ♦ quadrat ♦ transect (line) ♦ nets ♦ traps (pitfall, camera, mammal) ♦ capture–mark–recapture	Carry out transect studies — including use of quadrats — to identify changes in flora across a path or in/out of woodland, down/across a rocky shore, or through sand dunes to their hinterland. Set out and monitor pitfall traps, mammal traps, or camera traps, in various types of habitat. Use dip nets to investigate aquatic invertebrates in rock pools, ponds, or river shallows.

Living environment	Suggested learning activities and resources
1 Investigating ecosystems and biodiversity	
	Use camera traps as a non-invasive method of investigating species' presence in school grounds. A small mammal trap, eg a Longworth trap could be used to investigate species in an area of long grass. Investigate invertebrates in tall grasses and hedges using sweep nets. Using pitfall traps, carry out a capture-mark-recapture exercise in different habitats to assess population size. Resources, including practical activities, available from: — STEM (including practical science lessons) — The Nuffield Foundation — Science and Plants for Schools (SAPS) — Royal Geographical Society — Open Air Laboratory (OPAL) — Scotland's Environment — Scottish Schools Education Research Centre (SSERC) — Marine Biological Association — North East Scotland Camera Trapping (Facebook page)

Living environment	Suggested learning activities and resources
1 Investigating ecosystems and biodiversity	
d Techniques to measure abiotic factors: ♦ aquatic — water flow rate, oxygen concentration, water pH, and water temperature ♦ terrestrial — temperature, light intensity, soil moisture, soil pH, wind velocity, wind direction, and precipitation	Measure a range of abiotic factors, eg light intensity (using a light meter), soil moisture (probe/oven), wind velocity (anemometer), soil pH (meter/pH paper), precipitation (measuring cylinder) Use resources in 1.c above Consult the Energy Saving Trust resource: — How to measure wind speed.
e Limitations of quantitative techniques and potential sources of error: ♦ quantitative techniques provide information about frequency and distribution ♦ the larger the sample the more reliable the results will be ♦ counts of individuals rely on accurate identification ♦ all measurements have a potential to introduce error: equipment should be calibrated and used appropriately The importance of random sampling and reliability of results: ♦ random sampling: every individual in a population has an equal chance of being selected ♦ reliability of results: the extent to which an experiment, test or other measuring procedure yields the same results on repeated trials	Assess practical activities and data collection for potential sources of error. Differentiate between reliability, accuracy, precision and bias. Consider different types of random sampling: simple, stratified, systematic, and use of random number generators. Resources available from: — Royal Geographical Society: sampling techniques — AQA GCSE Science: systematic errors

Living environment		Suggested learning activities and resources
1	**Investigating ecosystems and biodiversity**	
f	The effect of abiotic factors on the distribution of organisms.	Investigate the effect of abiotic factors on the distribution of an organism, eg the effect of light intensity on the distribution of daisies or the effect of tide-line on the distribution of barnacles. Use resources in 1c. Other resources: — OPAL: discover heathland — Scottish Seabird Centre
g	Identification of organisms through construction and use of paired statement keys.	Collect specimens of leaves, fruits, berries, etc and use to construct paired statement keys. Resources, including practical activities, available from SAPS

Living environment	Suggested learning activities and resources
2 Interdependence	
a Definitions: ♦ carnivore — an animal that only eats other animal material ♦ herbivore — an animal that only eats plant material ♦ omnivore — an animal that eats both plant and animal material ♦ detritivore — an animal that feeds on dead organic matter: wood louse, earthworm, maggot ♦ decomposer — bacteria and fungi that feed on dead organic matter at microscopic level ♦ producer — an organism that can produce its own food; usually a green plant that produces its own food via photosynthesis ♦ primary consumer — a herbivore that eats the producer in a food chain ♦ secondary consumer — an animal that eats the primary consumer in a food chain ♦ tertiary consumer — an animal that eats the secondary consumer in a food chain ♦ niche — the role played by a species within a community: where it lives, what it eats and what eats it	
b Food webs, in the context of one aquatic and one terrestrial ecosystem.	Use dip nets to investigate species living in a rock pool or pond, or use sweep nets and/or mammal traps to investigate species living in an area of long grass. Using the collected data, consider predator-prey relationships and niches within each of these habitats. Resources available from: — STEM: food webs and interdependence

Living environment		Suggested learning activities and resources
2	**Interdependence**	
c	Interdependence between plants and animals. Simple word equations for photosynthesis and respiration.	Problem-solving activities incorporating significance of 24-hour variation in photosynthesis and respiration. Resources, including practical activities, available from: — STEM: photosynthesis — SAPS — SSERC: photosynthesis
d	Energy flow through food webs.	Problem-solving activities including calculating energy losses and efficiency of energy transfer. Resources available from: — BBC GCSE Bitesize Science: energy flow — STEM (Catalyst): energy transfer — STEM: energy transfer in ecosystems
e	Energy loss through movement, heat and undigested material.	
f	Factors affecting food webs: predation, disease, competition, natural and human impacts.	Resources available from: — STEM: food webs and interdependence
g	Carbon cycle: ♦ The role of the carbon cycle in recycling nutrients. ♦ Processes in the biological carbon cycle: photosynthesis, respiration, feeding, decomposition, formation and combustion of fossil fuels.	Construct simple flow diagrams that illustrate cyclical activities. Resources available from: — STEM: nitrogen cycle — STEM: the carbon cycle — BBC GCSE Bitesize Biology: nitrogen and carbon cycles — NASA: the carbon cycle

Living environment	Suggested learning activities and resources
2 Interdependence	
♦ Organisms involved in the carbon cycle: the role of detritivores and decomposers.	
h Nitrogen cycle: ♦ The role of the nitrogen cycle in recycling nutrients. ♦ Processes: fixation (by soil bacteria, lightning), death/decay (decomposition by fungi and bacteria), nitrification and denitrification, nitrate absorption by plants, feeding by animals. ♦ Organisms involved in the nitrogen cycle: the roles of bacteria in fixation (free-living bacteria and root nodules on legumes), decomposition, nitrifying, and denitrifying.	Construct simple flow diagrams that illustrate cyclical activities. Resources available from: — BBC GCSE Bitesize Biology: water, nitrogen and carbon cycles — STEM: nitrogen cycle

Living environment	Suggested learning activities and resources
3 Human influences on biodiversity	
a Definitions: ♦ non-native species — a species introduced through human action (accidental or deliberate) outside its native distribution ♦ invasive non-native species (INNS) — any non-native animal or plant that has the ability to spread and cause damage to the environment, the economy, our health or the way we live ♦ indicator species — the presence, absence or abundance of certain living organisms that show an environment is affected by a particular set of environmental conditions	
b Human activities which have a positive and/or negative effect on ecosystems, with a focus on species reduction or increase, extinction and loss of biodiversity.	Research positive effects of human activities on biodiversity, eg conservation, reintroductions. Research negative effects of human activities on biodiversity/extinction, eg pollution. Resources on land remediation (in this case the transformation of a former coking plant) are available from The Avenue. Teachers and lecturers could link learning and teaching of this area with Geosphere — iron ore in Earth's resources.
c The role of a named indicator species in environmental monitoring.	Field study and/or data analysis on lichens and/or freshwater invertebrates as indicator species. Resources on lichens (air quality survey) are available from OPAL.

Living environment	Suggested learning activities and resources
3 Human influences on biodiversity	
d The impact of a named INNS on ecosystems.	Research invasive non-native species (INNS) and their impact on ecosystems. Resources available from: — GB non-native species secretariat (NNSS) — NatureScot
e Conflicts between land and/or water-based activities. At least two stakeholders using a single resource, with potential solution/compromise for shared use.	Research conflicts between activities and the environment, eg between sporting estates and conservation, intensive agriculture and biodiversity, users of a common water resource. Resources available from: — NatureScot, eg River Spey catchment management plan — Bioversity International — Game & Wildlife Conservation Trust — RSPB
f Relevant current national organisations: ♦ the role of Scottish Environmental Protection Agency (SEPA) as an environmental regulator ♦ the role of NatureScot (NS) as an environmental educator and advisor ♦ designation and purpose of Sites of Special Scientific Interest (SSSI) in Scotland	Research the main aims and purpose of SEPA and NatureScot. Research the role of SSSIs as a nature conservation tool. Resources available from: — SEPA — NatureScot — SSSIs

Earth's resources		Suggested learning activities and resources
1	**Overview of Earth systems and their interactions**	
a	Identification of the main Earth systems: geosphere, hydrosphere, atmosphere, and biosphere.	Study the Earth as a planet in space. Use AV resources, eg remote sensing imagery using visible and other wavelengths. Classify a selection of resources as physical, biological, renewable and non-renewable. Resources available from: — Earth Science Education Unit — Natural Environment Research Council (NERC) — NASA — Geology.com — US Geological Survey (USGS) — British Geological Survey (BGS) — Earth Learning Idea (ELI) (includes practical activities) — Dynamic Earth
b	Classification of resources into physical, biological, renewable and non-renewable.	

Earth's resources	Suggested learning activities and resources
2 Geosphere	
a Definitions: ♦ weathering — the exposure and breaking down of rocks in situ at the Earth's surface over geological time due to interaction with the atmosphere ♦ transportation — the movement of rock fragments by water, wind, ice or gravity from the place where they were originally weathered ♦ erosion — the breaking down of rock fragments into smaller pieces and sediments due to collision with other rock fragments during transportation ♦ deposition — the settling out of rock fragments and sediments after transportation by water, wind, ice or gravity ♦ igneous — rock that forms through the cooling of molten rock (magma) to a solid form in the upper crust or on the surface of the Earth ♦ sedimentary — rock that is formed from weathered rock fragments and sediments which have been eroded, transported, deposited, compacted and cemented ♦ metamorphic — rock that has been subjected to heat and/or pressure, permanently altering the minerals or internal structure ♦ rock — a solid mass made of one or more minerals ♦ mineral — an element or chemical compound formed as a result of rock cycle processes ♦ ore — a naturally occurring solid material from which a metal or valuable mineral can be extracted profitably ♦ porosity — a measure of a rock's ability to hold fluid ♦ permeability — a measure of the amount of water allowed to pass through a rock	Candidates could keep a glossary of terms and definitions.

Earth's resources	Suggested activities and resources
2 Geosphere	
b Structure of the Earth Core (inner and outer), mantle, and crust (oceanic and continental).	Make a model of the Earth's structure (avocado model). Resources available from: — Time for Geography — Iain Stewart: Earth: power of the planet (BBC DVD); Richard Hammond: Journey to the centre of the Earth (BBC DVD)
c Rock cycle processes: ♦ erosion ♦ weathering (physical, chemical, biological, link with soil formation) ♦ transportation ♦ deposition ♦ melting ♦ effects of heat and pressure ♦ formation of igneous (granite, basalt), sedimentary (sandstone, shale), and metamorphic (marble, slate) rocks.	Construct a diagram/model of the rock cycle using, for example, rocks and surface materials (weathered rock, river sediment). Resources available from — NatureScot: Scotland's rocks, landforms and soils — Landscape fashioned by geology (series of 21 NatureScot publications, free PDFs) — Scottish Geology — Geological Society — Edinburgh Geological Society — Geological Society of Glasgow — Earth Learning Idea (includes practical activities) — STEM: geological changes — rock formation and deformation
d Relationship between rocks, minerals, and ores ♦ rock — granite is mostly composed of quartz, biotite and feldspar minerals ♦ minerals — quartz (silica and oxygen), calcium carbonate (calcium, carbon and oxygen) ♦ ore — metallic iron can be economically extracted from iron ores.	Examine and classify a selection of rocks, minerals and ores.

Earth's resources	Suggested activities and resources
2 Geosphere	
e Properties of rocks: porosity and permeability.	Investigate the porosities and relative permeability of rocks, eg sandstone, clay, basalt. Measure porosity using, eg marbles and measuring cylinder. Resources available from: — Petroleum geology: porosity and permeability — Earth Learning Idea (includes practical activities)
f Limestone: ♦ formation (formed in shallow tropical sea water as a result of calcium carbonate precipitating out) ♦ extraction (quarrying) ♦ processing (cutting, crushing) ♦ uses ♦ environmental impacts of extraction and/or processing. Uses of limestone: cement manufacture, construction, agriculture, iron and steel manufacture.	Examine various types of limestone (eg coral limestone, shelly limestone, oolitic limestone, chalk, Portland stone). Investigate sources of limestone. Make and use limestone mortar. Examine the use of lime mortar in old walls and buildings. Investigate uses of limestone. Resources available from: — BBC GCSE Bitesize Science: limestone — Geology.com: limestone
g Geological carbon cycle; the role of limestone and coal as carbon sinks; and chemical weathering (carbonic acid).	Investigate how the geological and biological carbon cycle fit together. Resources available from: — British Geological Survey: the carbon story — NASA Earth Observatory: the carbon cycle — The biological carbon cycle

Earth's resources	Suggested activities and resources
2 Geosphere	
h Iron ore ♦ Formation (formed in sea water as a result of oxygen release by photosynthesising organisms; the oxygen combines with dissolved iron in the ocean to form iron oxide) ♦ extraction (opencast mining) ♦ processing (blast furnace) ♦ uses ♦ environmental impacts of extraction and/or processing. Processing: ore smelting in a blast furnace; inputs (iron ore, limestone, oxygen, coke) and outputs (pig iron, slag, carbon dioxide). Uses of iron: steel manufactured products, reinforced concrete, cast iron and wrought iron products.	Map worldwide iron ore deposits. Resources on land remediation (in this case the transformation of a former coking plant) are available from The Avenue. Teachers and lecturers could link learning and teaching of this area with Human influences on biodiversity in Living environment. Investigate uses of iron. Research steel production and use (statistics). Resources, including data, available from: — World Steel Association — World Coal Association: Steel production — Raw steel production statistics by country
i Crude oil ♦ formation (formed from the remains of small animals and plants that died and fell to the seafloor millions of years ago; compression and heating of these remains within the Earth's crust forms oil) ♦ extraction (drilling) ♦ processing (fractional distillation) ♦ uses ♦ environmental impacts of extraction, processing and uses.	Research and compare the main producers of crude oil. Resources available from: — STEM: oil and products from oil — BBC GCSE Bitesize Chemistry: how crude oil was formed — Green planet solar energy for all: fossil fuel formation — BP Educational Services (scroll down for video resources on crude oil for 14–16 year olds) — World Petroleum Council

Earth's resources	Suggested activities and resources
2 Geosphere	
Processing: fractional distillation (including role of temperature in formation of outputs), graduation in molecule size. Uses: domestic and industrial fuels, electricity generation, petrol, diesel, fuel oil, plastics, tar, bitumen, lubricants, roofing felt, medicines, and cosmetics. Environmental impacts of crude oil products.	

Earth's resources	Suggested learning activities and resources
3 Hydrosphere	
a Definitions: ♦ evaporation — the process of turning from liquid into vapour or gas ♦ condensation — the process of a vapour or gas turning into a liquid ♦ precipitation — moisture that falls from the air to the ground (rain, snow, sleet, hail, drizzle, fog, mist) ♦ transpiration — the evaporation of water from a plant's leaves, stem or flowers ♦ run-off — the precipitation that flows across the surface for the ground ♦ infiltration — the physical movement of water through soil (relative to the soil's porosity and permeability) ♦ percolation — the movement of water through soil by gravity and capillary forces ♦ throughflow — the horizontal flow of water within soil ♦ groundwater — water that occupies pore spaces in soil and bedrock ♦ groundwater flow — the movement of groundwater horizontally	Candidates could keep a glossary of terms and definitions.

Earth's resources		Suggested learning activities and resources
3	**Hydrosphere**	
b	Water cycle: evaporation, condensation, precipitation, transpiration, run-off, percolation, infiltration, throughflow, groundwater flow, storage.	Research and make/label a diagram of the water cycle. Resources available from: — The Met Office — NASA: water and energy cycle
c	Main stores of water: atmosphere, oceans, ice, freshwater (rivers, streams, springs), groundwater (soil moisture, rock pores and crevices), and aquifers.	
d	Uses of water: industrial, domestic, and agricultural.	Investigate uses of water. Resources available from: — Anglian Water: water usage calculator — Waterwise: water fact sheet — NASA: When it comes to water, you have to think global
e	Issues arising from availability of water resources in Scotland and the rest of the British Isles: drought and flooding. Role of SEPA in flood warning and water quality.	Construct a map showing areas of water surplus and deficit in the UK. Resources available from: — SEPA — SEPA interactive flooding model — Tweed forum catchment model
f	Energy from water: hydro-electric, tidal, wave, energy changes involved (kinetic to electrical).	Study/visit a hydroelectric power station. Make a working model of a hydroelectric power station. Resources available from: — Scottish Water

Earth's resources	Suggested learning activities and resources
3 Hydrosphere	
	— Energy Resources — GOV.UK: wave and tidal energy
g Requirements and considerations for siting hydro-electric and tidal power stations: ♦ hydro-electric power (HEP): steep gradient, high precipitation, narrow deep valley, impermeable geology, population density, proximity to National Grid, current land use ♦ tidal: narrow channel, large water volume, large tidal stream, population density, proximity to National Grid, current water use	Research micro hydro schemes. Resources available from: — Green Highland — The Green Age: hydroelectrical power — US Geological Survey: hydroelectrical power — STEM: tidal power — STEM: tidal turbine film clip

Earth's resources	Suggested learning activities and resources
4 Biosphere	
a Definitions: ♦ biomass — the mass of living or recently living plants or animals ♦ biofuels — combustible biomass or fuels derived biomass	Candidates could keep a glossary of terms and definitions.
b Oceanic and freshwater resources: economically important species of plants and animals.	Investigate resources currently being exploited for human use, eg fish, mammals, shellfish, seaweed. Resources available from: — Royal Society: future ocean resources — MarineBio: ocean resources
c Terrestrial resources: economically important species of domesticated and hunted animals, agricultural crops, forestry (native and plantation).	Investigate resources currently being exploited for human use, eg domesticated and hunted animals, agricultural crops, forestry (native and plantation), uses of timber (hardwood and softwood). Visit a forestry plantation.
d Energy from biological resources: biomass (wood, peat). Process of fermentation in formation of biofuels: conditions required for formation of peat (acidic and anaerobic), and methane as the primary biogas.	Investigate issues regarding the sources and uses of biological resources including biofuels, eg peat, biogas, bioethanol. Research and/or conduct experiments into the processes involved in fermentation, including the required conditions for biofuel formation. Resources available from: — STEM: short rotation coppice willow — STEM: article on biofuels from waste — GreenFacts: biofuels

Earth's resources	Suggested learning activities and resources
5 Atmosphere	
a Definition: ♦ natural greenhouse effect — the process by which radiation reflected from the Earth's surface is absorbed by gases in the atmosphere and prevented from escaping into space, thus keeping the Earth warmer than it would otherwise be	Candidates could keep a glossary of terms and definitions.
b Composition of the atmosphere (nitrogen, oxygen and carbon dioxide), and the importance of the 'natural' greenhouse effect.	Investigate the composition of the atmosphere. Resources available from: — NASA: the composition of planetary atmospheres — Space.com: Earth's atmosphere — British Geological Survey: the greenhouse effect
c Energy from wind, including energy changes involved (kinetic to electrical).	Visit a wind farm. Investigate electricity generation from wind turbines, both onshore and offshore. Resources available from: — BBC News: world's first floating offshore wind farm in Scotland — Energy Saving Trust: wind turbines — The Renewable Energy Centre — Crown Estate: offshore wind electricity — Young People's Trust for the Environment: renewable energy factsheets — BBC News: judge overturns wind farms block
d Requirements and considerations for siting wind farms: strong/steady wind flow, exposed site, population density, proximity to National Grid, current land/water use.	

Sustainability	Suggested learning activities
1 Introduction to sustainability	
a Definitions: ♦ sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs ♦ sustainability is the relationship or balance between social, economic and environmental issues ♦ global citizenship is an awareness of the world as a global community and recognition of the rights and responsibilities of citizens within it.	Candidates could keep a glossary of terms and definitions.
b Global citizenship: role of the United Nations sustainable development goals, education and personal responsibility.	Use local knowledge, guest speakers and include visits. Investigate eco-schools. Resources available from: — Oxfam — United World Schools — Eco-schools — UN: sustainable development goals

Sustainability	Suggested learning activities
2 Food	
a Definitions: ♦ food miles — the distance food travels from the time of its production until it reaches the consumer ♦ carbon footprint — the mass of carbon dioxide emitted by any specific activity ♦ carbon neutral — no net release of carbon dioxide into the atmosphere ♦ carbon offsetting — compensating for emissions of carbon dioxide into the atmosphere with an equivalent reduction in carbon dioxide emissions elsewhere	Candidates could keep a glossary of terms and definitions.
b Impacts (social, economic, environmental) of an increasing global population on food supplies.	Investigate trends in human population growth. Discuss human population change in relation to access to food, water and energy, and generation and management of waste. Resources available from: — BBC Bitesize Higher Biology: science of food production — Population Institute
c Strategies in farming for a secure food supply: intensive farming, genetically modified (GM) crops, and agrochemicals (fertilisers and pesticides).	Resources available from: — GOV.UK: the future of food and farming — Food and Farming Futures — STEM: genetic modification of plants and food security — International Union of Pure and Applied Chemistry (IUPAC): information on agrochemicals

Sustainability		Suggested learning activities
2	**Food**	
d	Organic farming, including advantages and disadvantages.	Visit a demonstration farm. Hold a class debate on organic vs chemical farming. Resources available from: — BBC GCSE Bitesize Geography: organic farming — Organic Research Centre — Soil Association — Channel 4 TV: food unwrapped
e	Strategies in freshwater and marine-based systems for a secure food supply: intensive fishing (trawling, dredging) and promotion of alternative species.	Visit local fishmonger/supermarket to find out origin of fish species on sale, and how they were caught (trawler, dredger, line). Investigate UK use of non-marketable fish species, including fish tasting. Produce a poster/display to promote an alternative species. Research the impact of tuna fishing: skipjack vs bluefin tuna Resources available from: — GOV.UK: UK sea fisheries annual statistics — Seafish — Marine Conservation Society — Seafood Scotland — Greenpeace: if you eat tuna you should know these five fish
f	Fish conservation approaches: marine conservation areas, zoning, and sustainable fishing methods (mesh size, net shape, days at sea, line fishing, hand diving).	

Sustainability		Suggested learning activities
2	**Food**	
g	Environmental impact of food distribution: food miles, carbon footprint, carbon neutral, carbon offsetting. Strategies to reduce carbon footprint.	Investigate where food is produced and distance travelled (food miles). Investigate local producers vs imports. Resources available from: — Food miles calculator — ETA: food miles — Carbon footprint — The Guardian: a complete guide to carbon offsetting — Climate Care: carbon offsetting

Sustainability	Suggested learning activities
3 Water	
a Definition: ♦ wastewater — water that has been used in the home, in a business, or as part of an industrial process	Candidates could keep a glossary of terms and definitions.
b Impacts (social, economic, environmental) of an increasing global population on water supplies. Clean water supplies in developing and developed countries.	Carry out an audit of household/school water use. Research water supply in two contrasting countries. Investigate a 'Jompy' boiler. Resources available from: — Water use calculator — Waterwise — World Resources Institute: water — World Bank: water — United Nations Water
c Issues arising from water use: ♦ industry — water pollution, effluents ♦ agriculture — water pollution, and change in water levels as a consequence of water abstraction and irrigation ♦ domestic — gardening, washing, cooking, heating, sanitary, may lead to water shortages in times of drought and to water use restrictions ♦ impacts on public health, contamination and pollution of water supplies, conservation, and tourism and recreation ♦ impact of wastewater, including untreated sewage, on aquatic ecosystems	Investigate how industries reduce water consumption locally and nationally. Resources available from: — Water pollution guide — UN Water: water scarcity — BBC News: planet under pressure

Sustainability		Suggested learning activities
3	**Water**	
d	Sustainable approaches to water use: methods of water conservation in domestic, agricultural and industrial contexts.	Investigate ways to reduce use of water in the home, school/college, and industry. Resources available from: — Green Facts: water resources — OECD: water and agriculture — EPA: using water efficiently, ideas for industry
e	Role of SEPA in monitoring and enforcement.	Visit SEPA website for information.

Sustainability	Suggested learning activities
4 Energy	
a Definitions: ♦ enhanced greenhouse effect — the enhancement of the natural greenhouse effect through man-made emissions of greenhouse gases, trapping increasing quantities of heat ♦ climate change — a large-scale, long-term shift in Earth's weather patterns or average temperatures.	Candidates could keep a glossary of terms and definitions. Research the difference between global warming and climate change.
b Impacts (social, economic, environmental) of an increasing global population on energy supplies.	Investigate personal, school/college energy use. Examine satellite images of the Earth at night. Analyse growth of renewables in Scotland. Resources available from: — Scottish Renewables — Scottish Government: renewable energy — World Population Balance: population and energy consumption Teachers and lecturers could link this area with content in Earth's Resources.

Sustainability		Suggested learning activities
4	**Energy**	
c	The ‘enhanced’ greenhouse effect. Carbon dioxide, nitrous oxide and methane, and their sources.	Research the difference between the natural and enhanced greenhouse effect. Resources available from: — British Geological Survey: the greenhouse effect — British Geological Survey: impacts of climate change — Joint Nature Conservation Committee (JNCC): the enhanced greenhouse effect — BBC GCSE Bitesize Science: global warming
d	Renewable and non-renewable energy sources and issues arising from their use.	Analyse the growth of renewables in Scotland. Resources available from: — Department for Environment, Food and Rural Affairs: energy from waste — Scottish Renewables — Energy UK — GOV.UK: UK energy Teachers and lecturers could link this area with content in Earth’s Resources.

Sustainability		Suggested learning activities
4	**Energy**	
e	Sustainable approaches to reduce greenhouse gas emissions in transport, industry, domestic, and agricultural contexts.	Investigate schemes introduced to reduce the number of vehicles in city centres, eg Park and Ride, congestion charges. Investigate carbon capture and storage. Resources available from: — Transform Scotland — Keep Scotland Beautiful: transport — GOV.UK: greenhouse gas emissions — Committee on Climate Change
f	Impacts (social, economic and environmental) of climate change: habitat loss, reduction in biodiversity, changes in species distribution, rising sea levels leading to flooding, loss of agricultural land, and loss of business.	Research the environmental impacts on land, air, water of producing energy from fossil fuels. Resources available from: — Met Office: impact of climate change — WWF: the effects of climate change — NASA: the consequences of climate change — David Suzuki Foundation: impacts of climate change — David Attenborough: State of the Planet (BBC DVD)

Sustainability	Suggested learning activities
5 Waste management	
a Definitions: ♦ reduce — to decrease the amount of waste produced ♦ reuse — to refill or find another use for a product without processing it other than cleaning ♦ recycle — to reprocess materials into new and useful products	Candidates could keep a glossary of terms and definitions.
b Increase in waste production as a result of an increasing global population and societal demands.	Resources available from: — BBC GCSE Bitesize Geography: waste and pollution — BBC World Service: waste packaging is swamping islands — BBC News: Earth is becoming 'planet plastic' — Hawaii: message in the waves (BBC DVD)
c Sustainable approaches to managing waste: reduce, reuse and recycle, and local initiatives to encourage these.	Investigate/visit local waste disposal and recycling centre. Investigate benefits of turning waste into a by-product, eg increases in profit and reduction in pollution. Resources available from: — TED talks: the global food waste scandal — Audit Scotland: sustainable waste management — Let's Recycle — Scotland's zero waste plan — SEPA waste data
d Role of SEPA in waste management.	Visit SEPA website for information.

Apparatus and techniques	Suggested learning activities and resources
In addition to the key areas, candidates must have knowledge of the following pieces of apparatus and techniques. Where it is not possible to carry out a practical technique, candidates should be made aware of the purpose and methodology of the technique through teaching. **Apparatus** ♦ beaker ♦ balance ♦ measuring cylinder ♦ dropper/pipette ♦ test tube ♦ stopwatch ♦ funnel ♦ crucible ♦ oven ♦ microscope ♦ choice chamber ♦ quadrat ♦ transect: tape measure or rope marked off in intervals ♦ metre stick ♦ nets: sweep, dip ♦ traps: pitfall, mammal, camera ♦ thermometer	Choosing from the activities suggested in this table, or carrying out other appropriate activities, allows candidates to become familiar with the pieces of apparatus and the techniques listed here.

Apparatus and techniques	Suggested learning activities and resources
♦ anemometer ♦ rain gauge ♦ floats ♦ test kits: soil pH, soil nitrate/nitrite ♦ ID cards/keys: plants, mammals, rocks **Techniques** ♦ sampling plants and animals ♦ identification of species using paired-statement keys ♦ measuring abiotic factors ♦ assessing distribution of a species by collecting discrete data via observation ♦ interpreting case study documentary evidence, including Ordnance Survey map content, sketch maps, photographic evidence, tabular data, and/or short passages of text — ability to read and provide grid references is not required.	Candidates may find these Ordnance Survey materials useful

Apparatus and techniques	Suggested learning activities and resources
Reporting experimental work/fieldwork	
Candidates should be familiar with the following: ♦ setting an aim and/or hypothesis ♦ describing experimental/fieldwork procedures ♦ drawing labelled diagrams of experimental/fieldwork apparatus ♦ presenting data in tabular form, with appropriate headings and units of measurement ♦ presenting data in graphical form: bar chart, line graph or other graphical form appropriate to environmental science, with appropriate scales, labels, keys and units ♦ including a line of best fit (straight or curved) on a scatter graph if appropriate, to represent the trend observed in experimental/fieldwork data ♦ comparing data sets ♦ drawing conclusions from the data, and related to the aim ♦ evaluating an experimental/fieldwork procedure and suggesting and justifying improvements	Choosing from the activities suggested in this table, or carrying out other appropriate activities, allows candidates to become familiar with the reporting practices listed here.
Calculations	
Candidates should be familiar with the following methods of calculation: ♦ average: mean ♦ ratio ♦ percentage ♦ percentage increase/decrease ♦ calculations involving number substitution in formulae	Choosing from the activities suggested in this table, or carrying out other appropriate activities, allows candidates to become familiar with the calculating methods listed here.

Preparing for course assessment

Each course has additional time which may be used at the discretion of teachers and lecturers to enable candidates to prepare for course assessment. This time may be used near the start of the course and at various points throughout the course for consolidation and support. It may also be used towards the end of the course, for further integration, revision and preparation and/or gathering evidence for course assessment.

During delivery of the course, opportunities should be found:

- for identification of particular aspects of work requiring reinforcement and support
- to develop skills of scientific inquiry and investigation in preparation for the assignment
- to practise question paper techniques

Developing skills for learning, skills for life and skills for work

Course planners should identify opportunities throughout the course for candidates to develop skills for learning, skills for life and skills for work.

Candidates should be aware of the skills they are developing, and teachers and lecturers can provide advice on opportunities to practise and improve them.

SQA does not formally assess skills for learning, skills for life, and skills for work.

There may also be opportunities to develop additional skills depending on approaches being used to deliver the course in each centre. This is for individual teachers and lecturers to manage.

Candidates are expected to develop broad generic skills as an integral part of their learning experience. This course specification lists the skills for learning, skills for life and skills for work that candidates should develop through this course. These are based on SQA's Skills Framework: Skills for Learning, Skills for Life and Skills for Work and must be built into the course where there are appropriate opportunities. The level of these skills will be appropriate to the level of the course.

For this course, it is expected that the following skills for learning, skills for life and skills for work will be significantly developed:

Numeracy

This is the ability to use numbers to solve problems by counting, doing calculations, measuring, and understanding graphs and charts. This is also the ability to understand the results. Candidates will have opportunities to extract, process and interpret information presented in numerous formats including tabular and graphical. Practical experiments and fieldwork will provide opportunities to develop time and measurement skills.

2.1 Number processes

Number processes means solving problems arising in everyday life through carrying out calculations, when dealing with data and results from experiments/fieldwork investigations and everyday class work, making informed decisions based on the results of these calculations and understanding these results.

2.2 Money, time and measurement

This means using and understanding time and measurement to solve problems and handle data in a variety of environmental science contexts, including practical and investigative.

2.3 Information handling

Information handling means being able to interpret environmental science data in tables, charts and other graphical displays to draw sensible conclusions throughout the course. It involves interpreting the data and considering its reliability in making reasoned deductions and informed decisions. It also involves an awareness and understanding of the chance of events happening.

Employability, enterprise and citizenship

4.6 Citizenship

Citizenship includes having concern for the environment and for others; being aware of rights and responsibilities; being outward looking towards society; being able to recognise one's personal role in this context; being aware of global issues, understanding one's responsibilities within these, and acting responsibly. Candidates will develop citizenship skills when considering ethical implications as well as the applications of environmental science on our lives.

Thinking skills

This is the ability to develop the cognitive skills of remembering and identifying, understanding and applying. The course will allow candidates to develop skills of applying, analysing and evaluating. Candidates can analyse and evaluate experimental/fieldwork and data by reviewing the process, identifying issues and forming valid conclusions. They can demonstrate understanding and application of concepts and explain and interpret information and data.

5.3 Applying

Applying is the ability to use existing information to solve environmental science problems in different contexts, and to plan, organise and complete a task.

5.4 Analysing and evaluating

This is the ability to solve problems in environmental science and make decisions that are based on available information. It may involve the review and evaluation of relevant information and/or prior knowledge to provide an explanation.

In addition, candidates will also have opportunities to develop literacy skills, working with others and creating.

Literacy

Candidates will develop the skills to communicate key environmental science issues clearly and effectively. Candidates will have opportunities to communicate knowledge and understanding, with an emphasis on applications and environmental, ethical and/or social impacts. Candidates will develop listening and reading skills when gathering and processing information.

Working with others

Learning activities provide many opportunities, in all areas of the course, for candidates to work with others. Practical experimental/fieldwork activities and investigations, in particular, offer opportunities for group work, which is an important aspect of environmental science and should be encouraged.

Creating

Through learning in environmental science, candidates can demonstrate their creativity. In particular, when planning and designing experiments/fieldwork/investigations, candidates have the opportunity to be innovative in their approach. Candidates also have the opportunities to make, write, say or do something new.

Appendix 2: question paper brief

The question paper will sample knowledge, understanding and skills from across the course.

Content

Overall, marks will be evenly distributed across each of the three content areas:

- Living Environment (33 +/- 6 marks)
- Earth's Resources (33 +/- 6 marks)
- Sustainability (33 +/- 6 marks)

Skills, knowledge and understanding in each section	Section 1	Section 2	Section 3	Total
Demonstrating knowledge and understanding of environmental science by making statements, describing information, providing explanations and integrating knowledge	46+/-5	10+/-2	14	70 +/-5
Applying knowledge of environmental science to new situations, interpreting information and solving problems				
Planning and/or designing experimental/fieldwork investigations to test given hypotheses or to illustrate particular effects	20+/-2	10+/-2	0	30+/-4
Selecting information from a variety of sources				
Presenting information appropriately in a variety of forms				
Processing information/data (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 experimental/fieldwork investigations				
Total	**66**	**20**	**14**	**100**

Grade 'A' type marks

Approximately 30% of marks are designed to be grade 'A' type marks.

Administrative information

Published: June 2021 (version 4.1)

History of changes to course specification

Version	Description of change	Date
2.0	Course support notes added as appendix.	September 2017
3.0	'Course assessment structure: assignment' section: minor amendments to pages 21–24 to clarify the research and report stages. 'Skills, knowledge and understanding for the course assessment', and 'approaches to learning and teaching' sections: information about reporting experimental work/field work (pages 15 and 63) updated to include scatter graphs.	October 2018
3.1	Scottish National Heritage acronym corrected on page 31 and 39.	February 2019
4.0	'Assignment overview' sub-section: 'topic must be chosen with guidance' rather than 'should'. 'Resources' sub-section: ♦ information added that there must be a range of topics available for candidates to choose from and that teachers/lecturers must minimise the numbers investigating the same topic within a class ♦ teachers/lecturers can supply a basic list of instructions for the experimental procedure ♦ information added to the bullet points about raw experimental data, internet/literature data and extracts ♦ list of items that candidates cannot have access to in the report stage replaced with 'Candidates must not have access to a previously prepared draft of a report or any part of a report.' Five statements added to clarify the conditions of assessment. Suggested learning activities: Link added for Forestry and Land Scotland.	September 2019

4.1	Scottish Natural Heritage (SNH) updated to NatureScot (NS) on page 7 and in course support notes on pages 32, 40, and 43. Hyperlinks checked and updated where required.	June 2021