Course Support Notes

Higher Environmental Science Course Support Notes

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

Contents

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Higher Environmental Science Course. They are intended for teachers and lecturers who are delivering the Course and its Units. They should be read in conjunction with the *Course Specification*, the *Course Assessment Specification* and the *Unit Specifications* for the Units in the Course.

General guidance on the Course

Aims

As stated in the *Course Specification,* the aims of the Course are to enable learners 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, including scientific evaluation, in an environmental science context
- develop the use of technology, equipment and materials, safely, in practical scientific activities, including using risk assessments
- 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 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

Progression into this Course

Entry to this Course is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- National 5 Environmental Science Course

There may also be progression from National 5 Biology Course or National 5 Geography.

More detail is contained in the Environmental Science Progression Framework. The Environmental Science Progression Framework shows the development of the key areas throughout the suite of Courses,

Skills, knowledge and understanding covered in the Course

Note: teachers and lecturers should refer to the *Course Assessment Specification* for mandatory information about the skills, knowledge and understanding to be covered in this Course.

Progression from this Course

This Course or its components may provide progression for the learner to:

- Higher in another science subject or Geography
- further study, employment and/or training

Hierarchies

Hierarchy is the term used to describe Courses and Units which form a structured sequence involving two or more SCQF levels.

It is important that any content in a Course and/or Unit at one particular SCQF level is not repeated if a learner progresses to the next level of the hierarchy. The skills and knowledge should be able to be applied to new content and contexts to enrich the learning experience. This is for centres to manage.

- Environmental Science Courses from National 3 to Higher are hierarchical.
- Courses from National 3 to Higher have Units with the same structure and titles.

Approaches to learning and teaching

The purpose of this section is to provide you with advice and guidance on learning and teaching. It is essential that you are familiar with the mandatory information within the Higher Environmental Science *Course Assessment Specification*.

Teaching should involve an appropriate range of approaches to develop knowledge and understanding and skills for learning, life and work. This can be integrated into a related sequence of activities, centred on an idea, theme or application of environmental science, based on appropriate contexts, and need not be restricted to the Unit structure. Learning should be experiential, active, challenging and enjoyable, and include appropriate practical experiments/ activities and could be learner led. The use of a variety of active learning approaches is encouraged, including peer teaching and assessment, individual and group presentations, role-playing and game-based learning, with learner-generated questions.

When developing your Environmental Science Course there should be opportunities for learners to take responsibility for their learning. Learning and teaching should build on learners' prior knowledge, skills and experiences. The Units and the key areas identified within them may be approached in any appropriate sequence, at the centre's discretion. The distribution of time between the various Units is a matter for professional judgement and is entirely at the discretion the centre. Each Unit is likely to require an approximately equal time allocation, although this may depend on the learners' prior learning in the different key areas.

Learning and teaching, within a class, can be organised, in a flexible way, to allow a range of learners' needs to be met and to ensure progression. The hierarchical nature of the new qualifications provides improved continuity between the levels. Centres can, therefore, confidently continue to organise learning and teaching strategies, in ways appropriate for their learners.

Within a class, there may be learners capable of achieving at a higher level in some aspects of the Course. Where possible, they should be given the opportunity to do so. There may also be learners who are struggling to achieve in all aspects of the Course, and may only achieve at the lower level in some areas. Teachers/lecturers need to consider the Course and Unit Specifications to identify the differences between Course levels. It may also be useful to refer to the Environmental Science Progression Framework .

When delivering this Course to a group of learners, with some working towards different levels, it may be useful for teachers to identify activities covering common key areas and skills for all learners, and additional activities required for some learners. In some aspects of the Course, the difference between levels is defined in terms of a higher level of skill.

An investigatory approach is encouraged in Environmental Science, with learners actively involved in developing their skills, knowledge and understanding by investigating a range of relevant environmental science applications and issues.

A holistic approach should be adopted to encourage simultaneous development of learners' conceptual understanding and skills.

Where appropriate, investigative work/experiments, in Environmental Science, should allow learners 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.

All learning and teaching should offer opportunities for learners to work collaboratively. Practical activities and investigative work can offer opportunities for group work, which should be encouraged.

Group work approaches can be used within Units and across Courses, where it is helpful to simulate real-life situations, share tasks and promote team working skills. However, there must be clear evidence for each learner to show that the learner has met the required assessment standards for the Unit or Course.

Laboratory work should include the use of technology and equipment that reflects 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. Appropriate risk assessment must be undertaken.

Learners, especially at Higher, would be expected to contribute their own time in addition to programmed learning time.

Effective partnership working can enhance the science experience. Where possible, locally relevant contexts should be studied, with visits where this is possible. Guest speakers from eg industry, further and higher education could be used to bring the world of environmental science into the classroom.

Information and Communications Technology (ICT) can make a significant contribution to practical work in Higher Environmental Science, in addition to the use of computers as a learning tool. Computer interfacing equipment can detect and record small changes in variables allowing experimental results to be recorded over long and short periods of time. Results can also be displayed in real time helping 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 then be downloaded and viewed for analysis. Digital/electronic technology may be used to support assessment of the Course Assignment.

Learning about Scotland and Scottish culture will enrich the learners' learning experience and help them 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.

Assessment should be integral to and improve learning and teaching. The approach should involve learners and provide supportive feedback. Self- and peer-assessment techniques should be encouraged, wherever appropriate. Assessment information should be used to set learning targets and next steps. Suggestions for possible contexts and learning activities, to support and enrich learning and teaching, are detailed in the tables below.

The **mandatory Course key areas** are from the *Course Assessment Specification*. Activities in the **suggested learning activities** are not mandatory. This offers examples of suggested activities, from which you could select a range of suitable activities. It is not expected that all will be covered. Centres may also devise their own learning activities. **Exemplification of key areas** is not mandatory. It provides an outline of the level of demand and detail of the key areas.

Living Environment

Mandatory Course key areas	Suggested learning activities	Exemplification of key areas
1 Investigating ecosystems and biodiversity a. Ecological terms to include habitat, community, biotic, abiotic, biomass, biodiversity, species, niche, population, adaptation, and competition (interspecific and intraspecific), edaphic, with named examples. b. Factors that influence biodiversity, in the context of one aquatic and one terrestrial ecosystem of international importance. c. Sampling plants and animals using a range of qualitative and quantitative techniques. ♦ Sampling techniques to include terrestrial and aquatic examples: transects, quadrats, nets (sweep, mist, dip), traps (mammal, moth, camera traps), bat detectors, electro-fishing, Tullgren and Baermann funnels, ♦ Qualitative: provide species lists ♦ Quantitative: provide information about numbers and densities	Carry out a fieldwork investigation into several local habitats, eg soil, forest, wetland, using appropriate sampling techniques. A range of ecosystems may be explored using fieldwork, a variety of media and internet research. Produce and present an investigation report.	Biodiversity refers to the variety of life, including genetic, species and ecosystem variation. For example: Scottish Flow Country, Great Barrier Reef, tropical rainforest. .

(cover/distribution, abundance/frequency measures) ♦ Importance of randomisation and statistical analysis in sampling, including reliability and validity of results		
d. Measuring related abiotic factors and their effects on the frequency and distribution of organisms, in the context of one aquatic and one terrestrial ecosystem. Abiotic factors to include: ♦ Aquatic: water flow rate, oxygen concentration, water pH, salinity, tidal effects ♦ Terrestrial: temperature, light intensity, soil moisture, soil pH, humidity, wind velocity and direction, precipitation, slope.	Collect and analyse data on abiotic factors studied through fieldwork and relate this to the distribution of organisms.	
e. The need for accurate identification of flora and fauna.	Identify flora and fauna using keys, during site visits and research.	Examples of species that are difficult to distinguish, eg Scottish and common crossbills, common and soprano pipistrelle bats, Scottish wildcat, bumblebee species.
f. Use and construction of paired statement keys (to identify at least five species)	Construct keys using principal features of flowering plants, vertebrates and invertebrates.	Given a table of characteristics, the candidate should be able to construct a paired statement key to identify at least five species

2 Interdependence a. Population dynamics in food webs, to include stability in populations, carrying capacity, mutualism, parasitism, commensalism, density-dependent and density-independent factors, with named examples.		
b. Energy conversion, transfer and loss in food chains and webs: photosynthesis and respiration as essential energy converting processes Gross and net productivity; ecological efficiency in food chains and food webs endotherms and ectotherms; impact on length of food chains	Use data collected from field study sites to investigate feeding relationships and construct food webs. Analyse food webs from various ecosystems. Use food web games (eg IT based) to show interrelationships. Investigate decomposers in relation to soil studies/ leaf litter analysis. Examine media/IT material and/or prepared specimens to illustrate symbiotic associations. Investigate the beneficial and detrimental effects of symbiosis on humans. Investigate primary productivity. Analyse data on energy transfer in food chains/webs and carry out calculations on per cent energy transferred and energy lost in food chains.	The emphasis should be on a range of examples and not an in-depth study. Only simple word equations of respiration and photosynthesis are required. Ecological efficiency is the transfer of energy through trophic levels up a food chain and through a food web. Endothermy restricts the length of food chains. Marine food chains tend to be longer with several ectotherms. Endotherms expend much of their energy intake on maintaining their body temperature.
c. The effects of biotic factors, to include predator-prey cycles, grazing, inter-specific and intra-specific competition.	Analyse data on predator-prey cycles and the effects of grazing. Investigate competition using eg IT material.	Competition occurs when the supply of some resources falls below the combined requirements of the individuals/species concerned.
d. Primary and Secondary succession. The sequence of seral succession from	Compare environmental distribution through eg graph interpretation, data	Succession as a process is driven by the organisms involved. These alter the

primary colonisers to climax community. Influence of climatic and edaphic factors on succession. e. Human impact on the process of succession. Plagioclimax community. Examples to include heather moors and chalk grassland.	handling exercises. Investigate succession in, for example, sand dunes or nutrient-rich lakes (with natural eutrophication), through simulations, maps etc	habitat conditions, making them less suitable for themselves and more suitable for the species next in the succession. Climate is not the same as weather. Candidates should be able to differentiate between these terms .
3 Human influences on biodiversity a. Human activities, in Scotland, through the Holocene period, which have affected ecosystems, from a positive and negative view-point. To include habitat destruction, species reduction and increase, changes in biodiversity and extinction, through deforestation, afforestation, grazing, hunting, Agricultural and Industrial Revolutions, wars, introduction of non-native species. b. Development of intensive agriculture (larger fields, fertilisers, pesticides, drainage of wetland ecosystems) and its impact on biodiversity. Effects to include eutrophication, bioaccumulation and biomagnification. c. Responses to eutrophication, bioaccumulation, and biomagnification, to	Investigate past influences using data-based case studies, maps, visits to museums/sites of archaeological interest. Research examples such as the Clearances (Highland and Lowland), alteration of the Flow Country, Langholm Study, sitka spruce cultivation. Comparison of food webs between native and plantation woodland. Research and appraise the advantages and disadvantages of these developments. Use modelling programmes. Review current legislation aimed at	 Emphasis should be on loss of biodiversity. Intensive agriculture was developed to provide food for an increasing population. Reasons for and ecological effects of each development. Check current policy and legislation.

include reduced use of fertilisers and pesticides, organic farming, specialised schemes, and education to promote protection of ecosystems.	minimising these impacts. Discuss Countryside National Code. Visit farm/arrange visit from RHET/RNCI. 'Blind' tasting of organic/conventionally produced food.	
d. Impacts on biodiversity of urbanisation, to include changes in land use, recreational use of land and water, construction of buildings and transport routes. Environmental assessment (EIA and SEA)	Compare historical town plans with recent ones to identify changes in land use. Investigate the effects of building on flood-plains.	Environmental assessment is a procedure that ensures that the environmental implications of development are considered before a development decision is made. Can be made for individual projects (EIA) or for public plans or programmes (SEA)
e. Formation of acid rain and the minimisation of its impacts on biodiversity	Investigate formation of acid rain. Produce display of the effects of acid rain on lichens, plants and animals. Carry out data analysis of weather patterns resulting in acid rain/examine statistics to show trends in the levels of emissions.	Details of the effect of acid rain on soil chemistry are not required
f. The impact of sewage (raw and treated) on freshwater ecosystems, including biological oxygen demand.	Investigate the impact of sewage on freshwater ecosystems.	Raw sewage provides substrate for bacteria, leading to de-oxygenation Treated sewage provides mineral nutrients which lead to eutrophication and potentially to de-oxygenation.
g. The importance of indicator species, to include fresh water invertebrates (stonefly larvae and blood worms) and lichens.	Field study and/or data analysis on invertebrates and lichens as indicator species.	Lichens as indicators of high air pollution by SO_2; stonefly larvae as indicators of high oxygen concentrations in water; and blood worms of low oxygen concentrations in water.
h. The impact of climate change on biodiversity and species distribution.	Investigate eg arctic hare, alpine flowers in Scotland, bird species expanding breeding	Global warming refers to increases in average temperature near the Earth's

	range into the UK. Use Woodland Trust's 'Nature's Calendar' to record first sighting of species; use to find out if species are appearing earlier in the year than usual	surface. Climate change includes global warming and other changes brought about by increasing levels of greenhouse gases in the atmosphere eg changes in weather patterns, snow/ice cover, ecosystems, biodiversity Examples could include: higher spring temperatures causing earlier flowering of species such as blackthorn in Scotland; milder winters causing increased overwintering of migrant bird species such as the blackcap in Scotland. Other possible examples include: ruddy duck, New Zealand flatworm, giant hogweed, Himalayan balsam, Japanese knotweed
i. The impacts of non-native species and methods to minimise these impacts. Impacts to include loss of native species through competition, hybridisation with native species. Examples to include grey squirrel, sika deer and *Rhododendron ponticum* j. Reintroduction to Scotland of nationally extinct species, both current (sea eagle, beaver) and potential (wolf, lynx)	Investigate the work of bodies such as SNH, the Tweed Foundation and local authorities on minimising the effects of non-native species.	
k. The need for legislation and policies, to include current conservation and land/marine management policies. Key role of SSSIs. Role of statutory agencies		Review current legislation eg Wildlife and Countryside Act, Town and Country Planning Act, National Parks and Access to the Countryside Act,

(SNH, SEPA, FCS, MS)		Countryside (Scotland) Act, Marine (Scotland) Act Candidates should be familiar with the roles and responsibilities of Scottish Natural Heritage (SNH), Scottish Environmental Protection Agency, Forestry Commission Scotland (FCS), and Marine Scotland (MS)

Earth's Resources

Mandatory Course key areas	Suggested learning activities	Exemplification of key areas
An overview of Earth systems and their interactions underpins the key areas in this Unit: ♦ Geosphere, hydrosphere, biosphere and atmosphere as Earth systems ♦ Interactions, including the cycles, among the geosphere, hydrosphere, biosphere, atmosphere, and pedosphere Definition and classification of physical, biological, renewable and non-renewable resources. For candidates attempting Higher Environmental Science without first completing the National 5 course, it would be appropriate to ensure there is a grounding in basic Earth Science, in particular: ♦ Rock cycle processes involved in igneous, sedimentary and metamorphic rock formation ♦ Earth structure and history ♦ Mechanisms around plate tectonics ♦ Surface processes including cycle of erosion and types of weathering.		
1 Geosphere a. Mechanisms of destructive and construction plate boundaries, and their role in the formation of named mineral deposits, including major mineral ores	Study of the Earth by means of remote sensing imagery using, for example, satellite, aerial photography, Google Earth, visible light, UV, infra-red, radar, lasers. Examine examples of false colour images. Websites relating to remote sensing: CEOS (Committee on Earth Observation Satellites) GEO (Group on Earth Observations) GEOSS (Global Earth Observation System of Systems) Canada Centre for Remote Sensing ISPRS (International Society for Photogrammetry and Remote Sensing). European Association of Remote Sensing Laboratories — Education Resources.	Candidates should understand the mechanisms of destructive and constructive plate margins. In particular there should be an understanding of the role of rising magma at subduction zones for the emplacement of major minerals ores, including metallic minerals such as gold, silver and lithium. The Andes are an excellent example of both the physical processes and the issues relating to mineral extraction.

	tolu.giub.uni-bonn.de SETI Institute: Mysteries of Science GLOKAL Change Edinburgh University — geosciences USGS	
b. Plate movements (past and present) and the effect on resource distribution	Trace outlines of Africa and South America from a globe and fit them together. Investigate how plate movements have influenced the formation of copper deposits in Cyprus and in the Andes and petroleum in the North Sea.	Understand how plate movements have resulted in regions that were once active (and so developed key mineral deposits) now being in passive tectonic areas. The mineral/ resource distributions around the globe can act as a indicator of past plate movements. The development and evolution of basins during plate movements can also be responsible for deposits such as North Sea petroleum.
c. Aluminium: formation, discovery, extraction, processing of aluminium ore and uses of aluminium.	Map the world-wide distribution of bauxite deposits. Explain why they are distributed in this way. Construct a poster to show the uses of aluminium.	Candidates should be able to describe and explain formation, discovery, extraction, processes and uses
d. Clay and barite: formation, discovery, extraction and uses of barite (oil drilling and biomedical imaging) and clay (firebricks, bricks, tunnel and ditch support, ceramics, fuller's earth, cat litter, fining beer).	Investigate uses of barite eg why the high density makes it a useful additive to drilling mud, why it is used for barium meals. Investigate uses of clay.	Candidates should be able to describe and explain formation, discovery, extraction, processes and uses of clay and barite.
e. Shale oil and shale gas formation,		Candidates should be able to describe

discovery, extraction, processing and use, including the wider social issues relating to these f. Sources of the Earth's internal heat, heat flow and geothermal power	Investigate internal heat sources including fission.	and explain formation, discovery, extraction, processes and uses of shale oil and shale gas, and issues associated with fracking
g. Appraisal of the role of named legislation, policies, and initiatives for the protection, promotion and sustainable use of the geosphere; policies to include SSSI, Fossil Code, and Geoparks. Intrinsic value of the Earth's surface, to include tourism, recreation, quality of life measures.	Websites relating to the geosphere: Economic Geology tripod.com USGS earthsci.org Society of Economic Geologists Freie Universität Berlin Sam Davyson Chemguide The Barytes Association British Glass Atomic Archive Massachusetts Institute of Technology Alternate Energy Sources Benefits of Nuclear Power World Nuclear Association UNICEF geology.com www.europeangeoparks.org	Candidates should fully appreciate that the Earth's surface (its rocks, geomorphology and landscapes) have an intrinsic value beyond its value as simply an extractable resource. This value can be seen in tourism, leisure and recreation and quality of life measures. As a result there is the need for policies, legislation and initiatives that both protect and promote our Earth Heritage. Examples of this might include: SSSIs (as seen in *Living Environments*) - often designated for geomorphological and geological reasons. These include fossil beds, glacial features, coastal features and many others. Fossil Code - the Nature Conservation (Scotland) Act 2004 includes the Scottish Fossil Code. This includes best practice for field workers and aims to enhance public interest and awareness. Geoparks – these are territories with outstanding earth heritage that are using this to promote a range of sustainable development and educational activities. There are geoparks around the world. Currently Scotland has two geoparks (NW Highlands and Shetland), which are

		both part of the European and Global Geopark Networks. The European Network works in collaboration with UNESCO.
2 Hydrosphere a. Water movement within the hydrological cycle, to include: ♦ Hydrological cycle: states (solid ice, liquid water, water vapour), movement processes (evaporation, condensation, precipitation, transpiration, sublimation), and storage (both surface and subterranean) ♦ Interpretation of hydrographs	Study hydrographs of Scottish/major rivers running in areas of different climates (eg compare the hydrograph of the Nile with that of the Congo). Make a model of an artesian well. Make a model of a sub-artesian well and extract water from it.	Candidates should appreciate the different ways that water can exist within the hydrological cycle (as solid ice, liquid water & water vapour). The cycle includes areas of water storage on the Earth's surface and in subterranean storage including aquifers.
b. Factors influencing oceanic circulation.	Examine maps of ocean currents to see the effects of the Coriolis force. Investigate ocean surface currents. Investigate why UK seas are ice-free while ice forms at similar latitude Hudson bay. Design/carry out experiment with water at different temperatures and salinity. Examine satellite images of sea surface temperature.	Continental location, prevailing wind direction, Coriolis Effect (generating ocean gyres). There are also temperature and salinity gradients that influence the global oceanic conveyor and surface currents.
c. Changes in sea-level relative to land, including isostatic and eustatic change.		Candidates should appreciate isostatic changes resulting from crustal loading (including fore-bulge collapse as witnessed in the British Isles since the Last Glacial Period) and eustatic changes associated with changes to the volume of water. This is also linked to

		the volume of land-based ice as well as hydro-thermal expansion. Candidates should be critical of the impact that the collapse of floating ice-shelves and sea ice can have on relative sea levels.
d. Problems arising from unequal distribution of water resources — areas of surplus and deficit.	Annotate a map with global/national areas of deficit and surplus. Consider reasons for conflicts between countries regarding water resources. Investigate use and reuse of water from rivers (eg Rhine, Danube, Rio Grande) that flow though different countries or that form international boundaries. Explain how different countries cooperate to protect the river and what conflicts arise. Use Google Earth to locate areas where desert is expanding.	This should be considered at both a national and international level. There are very few rivers with international agreements on extraction by the nation states within the catchment area. For example in the past Egypt has declared that any upstream damming of the Nile would be seen as an act of aggression.
e. Water transfer schemes — the movement of water from surplus to deficit areas.	Investigate the uses of the water and dams of a river eg Colorado. Examine hydrographs of the Colorado River before and after construction of the Hoover Dam (1935) and the Glen Canyon Dam (1963). Explain why the form of the hydrograph and the discharge change.	Candidates should make full use of hydrographs to understand changes in discharge within river basins and how this can aid decision-makers during large scale water management projects.
f. Uses of water for paper making, brewing, whisky distilling, irrigation.	Make paper. Investigate alcohol production eg visit brewery, distillery. Investigate irrigation methods and use Google Earth to locate irrigated areas.	An appraisal of how water is used by different industries within river basins and how this can result in conflict.
g. The hydrogen economy, to include source, production and potential for use.	Make hydrogen by electrolysis of water.	Candidates should be able to describe and explain source, production and

	Websites relating to Hydrosphere: HistoryofWaterFilters.com DEFRA USGS (United States Geological Survey) UK Groundwater Forum The University of Arizona The Guardian UNESCO FAO Open University Al-Hekma international School ETH (Eidgenössische Technische Hochschule Zürich) CA and CC Press (Sweden) SEPA International Commission for the Protection of the Rhine European Environment Agency European Commission — Eurostat CWAC (Clean Water Action Council) UNEP GRID-ARENDAL	potential for use of hydrogen Hydrogen is a potential fuel of the future. The hydrogen economy is a proposed system of delivering energy using hydrogen. Advantages and disadvantages of hydrogen as a fuel. The hydrogen could be used either by burning to generate heat or by fuel cells to generate electricity Approximately 90% of hydrogen currently comes from the steam reforming of natural gas. A fuel cell is an electrochemical energy conversion device that converts hydrogen and oxygen into water and electrical energy.

3 Biosphere a. Soils: inputs and processes involved in formation, structure and composition of podzols and brown earths, to include soil profiles. Commercial use related to podzol and brown earth soil types.	Analysis of soil types to include humus, mineral content and water content. Label soil profiles of a podzol and a brown earth soil.	Coal and petroleum, though of biological origin, are classified as physical resources. Soil is of mixed biological and physical origin. Candidates should be able to understand and produce annotated soil profiles of both podzols and brown earths. The role of temperature and precipitation (and the resulting biological conditions) should be fully understood. The process of leaching is important for both soils (though to very different extents). Candidates should be able to justify why podzols are often better suited for forestry while brown earths can support arable farming.
b. Seaweed. Resources obtained from seaweed, including alginates. Uses include in food processing, fertilisers and cosmetics.		This should be appreciated in terms of large scale industrial processing of seaweed as well as small scale artisan processing in areas such as Ireland where seaweed/dulse is rising in popularity as a healthy, environmentally-friendly ingredient.
c. Barley. ♦ Factors that impact on barley production: edaphic (soil), abiotic and anthropogenic. ♦ Uses to include whisky distilling and brewing (including importance of nitrogen content to both), and food processing.	Investigate uses of barley. Visit a distillery	Barley is the key arable crop in Scotland, with Spring and Winter varieties. The nitrogen levels in barley are key to its usage; with low nitrogen yields being desired by the whisky industry whilst brewers will demand high nitrogen levels.

d. Processed biofuels, including biodiesel, bio-crude oil, biomethanol and bioethanol. Advantages and disadvantages of using processed biofuels.	Investigate different generations of biofuels. Websites relating to Biosphere: The Macaulay Institute FAO geographypages.co.uk geogonline.org.uk highergeography.co.nr scribd.com (World Soil Resources Report) erudite.org soil-net.com ryanandrum.com oilgae.com c-greensolutions.com barleyfoods.org barleyisbetter.com European Biofuels Technology Platform biofuelsdigest.com technologyreview.com National Renewable Energy Laboratory Biofuelsandthepoor.com Europa.eu (Biofuels Advisory Research Council) Renewableenergyindex.com Hubpages	A biofuel is a hydrocarbon that is made by or from a living organism and that can be used for power. A processed biofuel is one that has been subject to an industrial process.
3 Atmosphere		
a. The Structure and composition of the Earth's atmosphere ♦ Structure: troposphere, stratosphere,	Investigate the percentages of the main atmospheric gases. Changes of temperature with altitude within the layers of the	

mesosphere, thermosphere, exosphere ♦ Composition: carbon dioxide, methane, water vapour, ozone, nitrogen, oxygen ♦ Effect of albedo	atmosphere.	
b. Atmospheric circulation including heat and moisture transfer: ♦ Global energy budget ♦ Tri-cellular model ♦ Rossby waves ♦ Surface wind patterns. ♦ Coriolis effect	Global Energy Budget & Latitude.	Atmosphere transfers heat from tropics to colder areas (Global Energy Budget). 3 Cell Model with Rossby Waves Biomes associated with High pressure: Hot Deserts / Tundra Biomes associated Low Pressure: Rainforests / (equatorial and temperate) Surface Winds moving from High to Low pressure areas. Coriolis effect. Development of waves (surface wind, fetch).
c. Climate variability. Natural and anthropogenic causes. Climate zones/biomes		Natural variability – cosmic changes, plate tectonics, volcanic activity and sun spot activity. Anthropogenic causes – carbon dioxide emissions, methane release (from farming and permafrost) , deforestation and halons (a group of carbon compounds which contain halogens).
c. Wave power. Advantages and disadvantages.	Investigate the pros and cons of generating electricity using wave power. Research how a device such as the Pelamis generates electricity. Ocean Energy Council: oceanenergycouncil.com/index.php/Wave-	Location factors Logistics of installation Costs Impact on environment and user groups (fishermen).

	Energy/Wave-Energy Pelamis: pelamiswave.com/wave-power	

Sustainability

Mandatory Course key areas	Suggested learning activities	Exemplification of key areas
Introduction to Sustainability Sustainability and sustainable development within both more economically developed countries (MEDC) and less economically less developed countries(LEDC) underpins the key areas in this Unit. Sustainable development is development that "meets the needs of the present without compromising the ability of future generations to meet their own needs". (Brundtland Report/Our Common Future (UN) In this Unit, ecological and sustainable practices should be considered and compared with industrial and agricultural perspectives. This Unit can be considered in conjunction with other Units of Environmental Science.		
1 Food a. Increasing demand for global food supplies due to increasing population and changing consumer demands, changes brought about by development, and the effects on food security.	Investigate causes of exponential human population growth and its effect on food supply. Carry out a comparison of food intake in EMDC and ELDC. Investigate changing demands as countries become more developed and switch diets and resulting impacts on food provision. Website — fao.org	Causes of population growth may include advances in medical treatment and sanitation. More affluence has resulted in more meat consumption in many places that may impact on farming practices and sustainability. Some stages and challenges to food security/insecurity are defined in UN FAO publications.
b. Global strategies to increase food production: ♦ Land-based food production systems, to include mechanisation, use of fossil fuels in food production, agrochemicals (fertilisers, pesticides), irrigation, land management (crop rotation, drainage, hedgerow removal, cultivation of marginal land,	Investigate an agricultural system with focus on maximising yields and consider possible environmental impacts of such practices eg 'Green Revolution' (rice farming) in the Asian sub-continent, cereal farming in the North American prairies. Investigate an aquaculture system, with focus on maximising yields and consider	

conservation practices, diversification), genetic engineering, GM crops, high yield varieties, selective breeding, hydroponics. ♦ Aquatic food production systems, to include aquaculture (high density cages, pesticides, selective breeding, GM crops, hormone use) and marine fishing. ♦ Appraisal of these strategies, including their social, economic and environmental impacts	possible environmental impacts of such practises eg salmon farming off the Scottish west coast, Norwegian fjords, Alaska/western Canada, catfish in southern USA (Mississippi Delta)/SE Asia.	
c. Government role in food production: ♦ The EU role in farming and fishing legislation (CAP and CFP) ♦ The advisory role of the UN in relation to organic farming, biofuel and diversification. ♦ Appraisal of current UK/Scottish policies and legislation, including consideration of the reason(s) underpinning the policies and impacts of the policies	Investigate current EU and UN policies relating to food production, such as the Common Agricultural Policy (CAP) and the Common Fisheries Policy (CFP). Research the changing policy focus eg yield-driven, environmental stewardship.	Appraisal should include consideration of the reasons underpinning policy documents and impact of those policies eg have the limitation on days at sea or quotas had an impact on threatened species?

2 Water		
a. Increasing global water demand due to population pressure, agriculture, industry and development	Investigate the effect of exponential human population growth on water demand and sustainability of supply. Carry out a comparison of water use in ECMD and ECLD countries. Investigate sustainable approaches including examples from ECMD and ECLD countries eg comparison of supplies in Arizona with sub-Saharan Africa.	More people need more water for drinking etc but in addition to this more water is required for more agriculture and industry. More affluence results in more demand for water.
b. Sustainable management of water resources, to include reservoirs and groundwater storage; water conservation in domestic, industrial and agricultural usage; desalination (including reasons for desalination, and use of distillation and membrane filtration methods); and irrigation (including drip irrigation and drought resistant crops).	Research water conservation methods and appraise the effects and impacts of the methods.	Water conservation methods, such as low flush toilets, water-free urinals, 'grey water' (recycling waste water from processes such as washing dishes, laundry and bathing and reused typically for irrigation), rainwater harvesting, efficient appliances (washing machines and dishwashers), drip irrigation in agriculture.
c. Global attempts to increase access to clean water, and methods to improve quality of water supply, to include filtration, purification and disinfection to prevent spread of water-borne diseases.	Investigate UN Millennium Development Goals to improve National to clean water and sanitation for all. Visit local water treatment developments. Research new filtration technologies (micro-membranes, ultra-filtration), disinfection systems using ultrasound, ultraviolet light, water monitoring systems.	
d. Sewage treatment, to include screening, settling, filter beds, anaerobic digestion, disposal or use of resulting	Research treatment methods eg septic tanks, pit latrines, composting toilets, piped removal, sewage farms and use of	

materials.	biotechnology in sewage treatment. Appraise the environmental impacts of such treatments and consider where these treatments may be used most. Visit sewage works.	
e. The EU role in water quality and the advisory role of the UN and the input of non-governmental organisations (NGOs), including appraisal of named examples.	Research EU Water Framework Directive, and NGOs eg Oxfam, British Red Cross (work in water and sanitation eg in Ethiopia).	Candidates should be able to name and discuss current EU roles and NGOs they have studied.
3 Energy a. Increasing global energy demand due to population increase, consumerism; changes in demand from different sectors (transportation, domestic, agriculture, industry) and from different stages of development (eg MEDC and LEDC)	Carry out an analysis of trends in global energy use.	
b. Build-up of anthropogenic greenhouse gases and the enhanced greenhouse effect; the work of the IPCC	Investigate data on increasing atmospheric carbon dioxide levels.	Carbon dioxide released from the burning of fossil fuels in power stations and vehicles. Methane released in large quantities from landfill and livestock.
c. Environmental, social and economic impacts of climate change, including sea level rise, impact on ocean currents, desertification, crop failures and famine, and changing weather patterns.	Consider different viewpoints in the media in relation to climate change. View BBC 'Power of the Planet' series.	Current examples for consideration may include sea level rise (Bangladesh, Maldives), desertification (Sahara desert), crop failures and famine (Ethiopia), changing weather patterns (Australian droughts).
d. Appraisal of sustainable strategies to reduce greenhouse gas emissions,	Investigate sustainable strategies to reduce greenhouse gases eg hybrid cars,	

including energy conservation, energy taxation, hybrid vehicles, and energy efficient appliances and engines.	hydrogen fuel cells, Scottish Renewables Obligation.	
e. Nuclear power generation, including fission and nuclear waste, and advantages and disadvantages of nuclear power generation compared with those of fossil fuels and renewable sources. Disposal, storage and possible long term effects of nuclear waste.	Visit a nuclear power station. Research recent nuclear disasters eg Fukushima and consider the longer term effects as evidenced by Chernobyl Use information from different sources including lobby groups such as Greenpeace to consider the advantages and disadvantages of nuclear power generation.	The role of nuclear isotopes as an alternative fuel to fossil fuels and renewable sources. Disposal, storage and possible long term effects of nuclear waste.
f. Appraisal of named national and international policies and legislation on energy, to minimise greenhouse gas emissions from energy production.	Carry out research on relevant legislation and approaches eg Climate Change (Scotland) Act 2009, UK Climate Change Act (2008), UK Carbon Plan, European Union: ETS. Investigate role of the UN to co-ordinate a global approach in reducing emissions: 1997 Kyoto Protocol and subsequent conferences.	Individual policies and legislation have not been specified but candidates should be able to name and discuss the aim of current policies and legislation they have studied.
4 Waste management		
a. Increased global waste production due to increased population, consumer demands, globalisation of supply chains, and obsolescence of technological goods	Investigate technological and psychological obsolescence. Research the benefits of packaging fresh food eg cucumbers.	Obsolescence - technological gadgets are often replaced for a newer model by many affluent consumers when they are still functioning. Packaging is used to facilitate transport and storage of products to protect them from damage. It is used to display products such as food and technological

		gadgets. Packaging protects against unnecessary waste. Most packaging is considered to be waste.
b. Waste management, to include: ♦ minimisation: improved quality control and process monitoring, food use-by dates and impact on food waste, education. ♦ reuse and preparation for reuse ♦ recycling: advantages and disadvantages ♦ energy recovery ♦ disposal: advantages and disadvantages of incineration, landfill and composting.	Research the European Waste Hierarchy (Article 4 of the WFD). Investigate the purpose of use-by dates. Investigate production of useful products from upgrading waste eg biogas and high quality protein foods (made from waste such as whey (from cheese making). Investigate coding system for recycling various plastics eg PET, HDPE, PVC, PS. Investigate landfill tax and Scotland's waste strategies. Investigate anaerobic digestion — gasification at landfill sites. Research the 'polluter pays principle' and the 'extended producer responsibility'.	
c. Life cycle analysis to examine the energy, materials and transport involved in making, using and disposal of a resource; appraisal of circular and linear economic models	Produce a life cycle analysis of a household object eg television, mobile phone. The Ellen Mcarthur foundation provides lots of information on the circular economy	The circular economy model has been devised as an alternative to the take, make, dispose (linear) model as a solution to waste.
d. Appraisal of named national and international policies and legislation to manage waste.	Research Scotland's Zero Waste Plan, role of SEPA in waste management, EU Landfill Directive, EU Waste Framework Directive, ISO 14001.	Individual policies and legislation have not been specified but candidates should be able to name and discuss the aim of current policies and legislation they have studied.

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

Learners are expected to develop broad generic skills as an integral part of their learning experience. The *Course Specification* lists the skills for learning, skills for life and skills for work that learners 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:

Literacy
Writing means the ability to create texts which communicate ideas, opinions and information, to meet a purpose and within a context. In this context, 'texts' are defined as word-based materials (sometimes with supporting images) which are written, printed, Braille or displayed on screen. These will be technically accurate for the purpose, audience and context.

1.2 Writing

Learners develop the skills to effectively communicate key areas of environmental science, make informed decisions and describe, clearly, environmental science issues in various media forms.
Learners will have the opportunity to communicate applied knowledge and understanding throughout the Unit, with an emphasis on applications and environmental/ethical/social impacts.

There will be opportunities to develop the literacy skills of listening and reading, when gathering and processing information in environmental science.

Numeracy
This is the ability to use numbers in order to solve problems by counting, doing calculations, measuring, and understanding graphs and charts. This is also the ability to understand the results.

Learners will have opportunities to extract, process and interpret information presented in numerous formats including tabular and graphical. Practical work 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/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.

2.3 Information handling

Information handling means being able to interpret environmental science data in tables, charts, maps 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. Learners will develop citizenship skills, when considering the applications of environmental science on our lives, as well as ethical implications.

Thinking skills

This is the ability to develop the cognitive skills of remembering and identifying, understanding, applying. The Course will allow learners to develop skills of applying, analysing and evaluating. Learners can analyse and evaluate practical work and data by reviewing the process, identifying issues and forming valid conclusions. They can demonstrate understanding and application of the key areas 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, such as an investigation.

5.4 Analysing and evaluating

Analysis 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. It may build on selecting and/or processing information, so is a higher skill.

5.5 Creating

This is the ability to design something innovative or to further develop an existing thing by adding new dimensions or approaches. Learners can demonstrate their creativity, in particular, when planning and designing environmental science experiments or investigations. Learners have the opportunity to be innovative in their approach.
Learners also have opportunities to make, write, say or do something new.

In addition, learners will also have opportunities to develop working with others.

Working with others

Learning activities provide many opportunities, in all areas of the Course, for learners to work with others. Practical activities and investigations, in particular,

offer opportunities for group work, which is an important aspect of environmental science and should be encouraged.

Approaches to assessment

Assessment should cover the mandatory skills, knowledge and understanding of the Course. Assessment should be integral to and improve learning and teaching. The approach should involve learners and provide supportive feedback. Self- and peer-assessment techniques should be used, whenever appropriate.

See the *Unit Support Notes* for guidance on approaches to assessment of the Units of the Course.

Scientific skills

Learners should acquire scientific skills through a series of learning experiences, investigations and experimental work. These skills should be developed throughout the Course using a variety of case studies, practical activities and other learning experiences, as appropriate. Some activities and experiences will lend themselves to developing particular skills more than others. For example, some practical activities will be particularly suitable for developing planning and designing skills, some for presenting and analysing data skills, and others for the skill of drawing conclusions. In selecting appropriate activities and experiences, teachers and lecturers should identify which skills are best developed in each activity to ensure the progressive development of all skills and to support learners' learning. Further details on the skills that should be developed in Course work are given below.

Selecting information

Select and analyse relevant information from texts, tables, charts, keys, graphs and/or diagrams. The study of environmental science involves dealing with written and visual information. Learners will often deal with more complex information than they can produce. Learners should be able to:

- work with quantitative and qualitative data, discrete and continuous data and sampled data
- deal with experimental data presented in tables, pie and bar charts, line graphs, lines of best fit, graphs with semi-logarithmic scales, graphs with error bars and information presented as box plots
- analyse and interpret typically two interconnected tables, charts, keys, graphs or diagrams or a single source of graphical information with two to three patterns, trends, conditions, variables or sets of results
- deal with statistical concepts such as the mean, range and standard deviation of data and statistically significant differences (as shown by error bars in graphs and plus and minus values in tables of results)
- deal with text to analyse its content, select appropriate information, identify and evaluate evidence, explain relationships, draw conclusions and display related knowledge
- use computers and software applications to search and retrieve relevant information

Presenting information

Present information appropriately in a variety of forms, including summaries and extended text, flow charts, keys, diagrams, tables and/or graphs.

(a) Representing data. Learners should be able to:

- present variables from experimental or other data in an appropriate form including tables, charts, keys, graphs and diagrams
- distinguish between dependent and independent variables

(b) Communication. Learners should be able to:

- select, organise and present relevant information, including presenting alternative points of view, on an environmental science issue
- produce scientific reports which describe experimental procedures, record relevant observations and measurements, analyse and present results, draw conclusions and evaluate procedures with supporting argument
- produce extended text presenting relevant ideas clearly, coherently and logically using specialist vocabulary where appropriate
- use word processing and graphics packages, spreadsheets and other data handling software

(c) Oral communication. Through discussion and presentations learners should be able to:

- convey information clearly and logically using specialist vocabulary where appropriate
- use images including charts, models, graphs, diagrams, illustrations or video in conveying information
- respond to others by answering questions, clarifying points, contributing points of view and asking questions to clarify or explore in greater depth

Processing information

Process information accurately, using calculations where appropriate. Learners should be able to:

- perform calculations involving whole numbers, decimals and fractions
- calculate ratios and percentages including percentage increase and decrease
- round answers to an appropriate degree of accuracy (eg to two decimal places or three significant figures)
- deal with a range of units in accordance with Society of Biology recommendations. Learners will be expected to be able to convert between, eg µg and mg
- deal with calculations involving negative numbers, numbers represented by symbols and scientific notation
- work with data to find the mean and range of the data
- calculate genetic ratios based on probability
- substitute numerical values into equations and changing the subject of an equation
- use software packages to carry out statistical and other data handling processes

Planning, designing and carrying out

Plan, design and carry out experimental procedures to test given hypotheses or to illustrate particular effects. This could include identification of variables, controls and measurements or observations required.

(a) Planning and designing. Learners should be able to:

- state the aim of an investigation

- suggest a hypotheses for investigation based on observation of environmental science phenomena
- plan experimental procedures and select appropriate techniques
- suggest suitable variables that could be investigated in a given experimental set up
- identify dependent and independent variables in an investigation
- decide on the experimental designs required to ensure the validity of experimental procedures
- decide on the measurements and observations required to ensure reliable results
- modify procedures in the light of experience

(b) Carrying out. Learners should be able to:

- identify component tasks in practical work and plan a procedure (to include timings and allocation of tasks where appropriate)
- identify, obtain and organise the resources required for practical work
- carry out work in a methodical and organised way with due regard for safety and with appropriate consideration for the wellbeing of organisms and the environment where appropriate
- follow procedures accurately
- make and record observations and measurements accurately
- capture experimental data electronically using a range of devices
- modify procedures and respond to sources of error

Evaluating experimental procedures

Evaluate experimental procedures by commenting on the purpose or approach, the suitability and effectiveness of procedures, the control of variables, the limitations of equipment, possible sources of error and/or suggestions for improvement. Learners should be able to:

- identify and comment on variables that are not controlled in experimental situations and distinguish between dependent and independent variables
- identify sources of error in measurements and observations
- identify and comment on the reliability of results
- identify and comment on the validity of experimental designs
- suggest possible improvements to experimental set-ups
- use observations and collected data to make suggestions for further work

Drawing conclusions

Draw valid conclusions and give explanations supported by evidence or justification. Conclusions should include reference to the aim of the experiment, overall pattern to readings or observations, trends in results or comment on the connection between variables and controls. Learners should be able to:

- analyse and interpret experimental data to select relevant information from which conclusions can be drawn
- state the results of the investigation
- draw conclusions on the relationships between the dependent and independent variables
- take account of controls when drawing conclusions
- analyse and interpret experimental data to identify patterns, trends and rates of change

Making predictions and generalisations

Make predictions and generalisations based on available evidence. Learners should be able to:

- predict the outcome in experimental situations from supplied information
- make generalisations from a range of environmental science information
- use modelling and simulation software to test predictions and answer questions related to environmental science and experimental phenomena
- use evidence to support a personal decision or point of view on a current scientific, technological, environmental or health issue.

See the *Unit Support Notes* for guidance on approaches to assessment of the Units of the Course.

Added value

At Higher, the added value will be assessed in the Course assessment.

Information given in the *Course Specification* and the *Course Assessment Specification* about the assessment of added value is mandatory.

Preparation for Course assessment

Each Course has additional time which may be used at the discretion of the teacher or lecturer to enable learners 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 for preparation for Unit assessment, and 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 practise skills of scientific inquiry and investigation in preparation for the Assignment
- to practise question paper techniques

Combining assessment across Units

If an integrated approach to Course delivery is chosen then there may be opportunities for combining assessment across Units. If this approach is used, then it is necessary to be able to track evidence for individual Outcomes and Assessment Standards.

Transfer of Evidence:
Evidence for the achievement of Outcome 1 and Assessment Standard 2.2 for this Unit can be used as evidence of the achievement of Outcome 1 and Assessment Standard 2.2 in the other Units of this Course.

Equality and inclusion

The following should be taken into consideration:

Situation	Reasonable adjustment
Carrying out practical activities.	Use could be made of practical helpers for learners with: ♦ physical disabilities, especially manual dexterity, when carrying out practical activities ♦ visual impairment who have difficulty distinguishing colour changes or other visual information
Reading, writing and presenting text, symbolic representation, tables, maps, graphs and diagrams.	Use could be made of ICT, enlarged text, alternative paper and/or print colour and/or practical helpers for learners with visual impairment, specific learning difficulties and physical disabilities.
Process information using calculations.	Use could be made of practical helpers for learners with specific cognitive difficulties (eg dyscalculia).
Draw a valid conclusion, giving explanations and making generalisation/predictions.	Use could be made of practical helpers for learners with specific cognitive difficulties or autism.

As far as possible, reasonable adjustments should be made for the Question Paper and/or Assignment, where necessary. All adjustments currently available for the Question Paper would be available for Component 1. Learners will have a choice of Assignment topic for Component 2, for which reasonable adjustments can be made. This includes the use of 'practical helpers', readers, scribes, adapted equipment or assistive technologies.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these Course Support Notes is designed to sit alongside these duties but is specific to the delivery and assessment of the Course.

It is important that centres are aware of and understand SQA's assessment arrangements for disabled learners, and those with additional support needs, when making requests for adjustments to published assessment arrangements. Centres will find more guidance on this in the series of publications on Assessment Arrangements on SQA's website: www.sqa.org.uk/sqa/14977.html.

Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- Assessment Arrangements (for disabled learners and/or those with additional support needs) — various publications are available on SQA's website at: www.sqa.org.uk/sqa//14977.html.
- *Building the Curriculum 3: A framework for Learning and Teaching*
- *Building the Curriculum 4: Skills for learning, skills for life and skills for work*
- *Building the Curriculum 5: A framework for assessment*
- Course Specifications
- Design Principles for National Courses
- *Guide to Assessment* (June 2008)
- Principles and practice papers for curriculum areas
- Science: A Portrait of current practice in Scottish Schools (2008)
- *SCQF Handbook: User Guide* (published 2009) and SCQF level descriptors (to be reviewed during 2011 to 2012): www.sqa.org.uk/sqa/4595.html
- *SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work*
- *Skills for Learning, Skills for Life and Skills for Work: Using the Curriculum Tool*

Administrative information

Published: May 2015 (version 2.1)

History of changes to Course Support Notes

Course details	Version	Description of change	Authorised by	Date
	2.0	Substantial changes to three column table page 7 onwards to add clarification Assessment Standard 2.2 & 2.3 removed	Qualifications Development Manager	June 2014
	2.1	Minor typographical changes made to spelling — barite	Qualifications Manager	May 2015

Unit Support Notes

Unit Support Notes — Environmental Science: Living Environment (Higher)

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

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Environmental Science: Living Environment (Higher) Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- the *Unit Specification*
- the *Course Specification*
- the *Course Assessment Specification*
- the *Course Support Notes*
- appropriate assessment support materials

General guidance on the Unit

Aims

The general aim of this Unit is to develop skills of scientific inquiry, investigation and analytical thinking, along with knowledge and understanding of the living environment.

Learners will apply these skills when considering the applications of the living environment on our lives, as well as the implications on society/the environment. This can be done by using a variety of approaches, including investigation and problem solving.

The Unit covers the key areas of:

- Investigating ecosystems and biodiversity
- Interdependence
- Human influences on biodiversity

Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Progression into this Unit

Entry to this Unit is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- National 5 Environmental Science Course

There may also be progression from National 5 Biology Course or National 5 Geography.

Skills, knowledge and understanding covered in this Unit

Information about skills, knowledge and understanding is given in the Higher Environmental Science *Course Support Notes*.

If this Unit is being delivered on a free-standing basis, teachers and lecturers should cover the mandatory skills and key areas in ways which are most appropriate for delivery in their centres.

Progression from this Unit

This Unit may provide progression to:

- other qualifications in Environmental Science or related areas
- further study, employment and/or training

Approaches to learning and teaching

Approaches to learning and teaching and suggested learning activities are covered in the *Course Support Notes*.

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

Information about skills, knowledge and understanding is given in the Higher Environmental Science *Course Support Notes*.

Approaches to assessment and gathering evidence

The purpose of this section is to give advice on approaches to assessment for the Unit. There will be other documents produced for centres to provide exemplification of assessments and guidance on how to write them.

Approaches to the assessment of a Unit when it forms part of a Course may differ from approaches to assessing the same Unit when it is not being delivered as part of a Course. If an integrated approach to Course delivery is chosen, then there may be opportunities for combining assessment across Units.

Assessments must be valid, reliable and fit for purpose for the subject and level, and should fit in with learning and teaching approaches.

Unit assessment should support learning and teaching and, where possible, enable personalisation and choice for learners in assessment methods and processes. Teachers and lecturers should select the assessment methods they believe are most appropriate, taking into account the needs of their learners and the requirements of the Unit.

There is no mandatory order for delivery of the Outcomes. These should be overtaken throughout the Unit and are an integral part of learning and teaching.

The table below gives guidance and advice on possible approaches to assessment and gathering evidence:

Strategies for gathering evidence
There may be opportunities in the day-to-day delivery of the Units in a Course to observe learners providing evidence, which satisfies completely, or partially, a Unit or Units. This is naturally occurring evidence and can be recorded as evidence for an Outcome or parts of an Outcome. In some cases, additional evidence may also be required to supplement and confirm the naturally occurring evidence. Approaches to assessment might cover the whole Unit or be combined across Outcomes. A holistic approach can enrich the assessment process for the

learner by bringing together different Outcomes and/or Assessment Standards. If a holistic approach is used, then it is necessary to be able to track individual Assessment Standard evidence.

Strategies for gathering evidence and ensuring that the learners' work is their own could include:

- personal interviews during which the teacher or lecturer can ask additional questions about completed work
- an oral presentation on their work
- writing reports in supervised conditions
- checklists to record the authenticity
- supplementary sources of evidence, such as witness testimony, film or audio clips

Evidence can be gathered from classwork, experiments, investigations and/or research carried out in this Unit. It can be obtained using one or more of the strategies outlined above or by alternative methods, which could include a test of knowledge, understanding and skills.

Combining assessment within Units

See *Course Support Notes*.

Equality and inclusion

The *Course Support Notes* provide full information on equality and inclusion for this Unit.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Unit Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

Alternative approaches to Unit assessment to take account of the specific needs of learners can be used. However, the centre must be satisfied that the integrity of the assessment is maintained and that the alternative approaches to assessment will, in fact, generate the necessary evidence of achievement.

Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- Assessment Arrangements (for disabled learners and/or those with additional support needs) — various publications are available on SQA's website at: www.sqa.org.uk/sqa//14977.html.
- *Building the Curriculum 3: A framework for Learning and Teaching*
- *Building the Curriculum 4: Skills for learning, skills for life and skills for work*
- *Building the Curriculum 5: A framework for assessment*
- Course Specifications
- Design Principles for National Courses
- *Guide to Assessment* (June 2008)
- Principles and practice papers for curriculum areas
- Science: A Portrait of current practice in Scottish Schools (2008)
- Research Report 4 — Less is More: Good Practice in Reducing Assessment Time
- Coursework Authenticity — a Guide for Teachers and Lecturers
- *SCQF Handbook: User Guide* (published 2009) and SCQF level descriptors (to be reviewed during 2011 to 2012): www.sqa.org.uk/sqa/4595.html
- *SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work*
- SQA Guidelines on e-assessment for Schools
- SQA Guidelines on Online Assessment for Further Education
- SQA e-assessment web page: www.sqa.org.uk/sqa/5606.html

Administrative information

Published: June 2014 (version 1.0)

History of changes to Unit Support Notes

Unit details	Version	Description of change	Authorised by	Date

Unit Support Notes

Unit Support Notes — Environmental Science: Earth's Resources (Higher)

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

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Environmental Science: Earth's Resources (Higher) Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- the *Unit Specification*
- the *Course Specification*
- the *Course Assessment Specification*
- the *Course Support Notes*
- appropriate assessment support materials

General guidance on the Unit

Aims

The general aim of this Unit is to develop skills of scientific inquiry, investigation and analytical thinking, along with knowledge and understanding of the Earth's resources.

Learners will apply these skills when considering the applications of the Earth's resources on our lives, as well as the implications on society/the environment. This can be done by using a variety of approaches, including investigation and problem solving.

The Unit covers the key areas of:

- the geosphere
- the hydrosphere
- the biosphere
- the atmosphere

Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Progression into this Unit

Entry to this Unit is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- National 5 Environmental Science Course

There may also be progression from National 5 Biology Course or National 5 Geography.

Skills, knowledge and understanding covered in this Unit

Information about skills, knowledge and understanding is given in the Higher Environmental Science *Course Support Notes*.

If this Unit is being delivered on a free-standing basis, teachers and lecturers should cover the mandatory skills and key areas in ways which are most appropriate for delivery in their centres.

Progression from this Unit

This Unit may provide progression to:

- other qualifications in Environmental Science or related areas
- further study, employment and/or training

Approaches to learning and teaching

Approaches to learning and teaching and suggested learning activities are covered in the *Course Support Notes*.

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

Information about developing skills for learning, skills for life and skills for work in this Unit, is given in the relevant *Course Support Notes*.

Approaches to assessment and gathering evidence

The purpose of this section is to give advice on approaches to assessment for the Unit. There will be other documents produced for centres to provide exemplification of assessments and guidance on how to write them.

Approaches to the assessment of a Unit when it forms part of a Course may differ from approaches to assessing the same Unit when it is not being delivered as part of a Course. If an integrated approach to Course delivery is chosen, then there may be opportunities for combining assessment across Units.

Assessments must be valid, reliable and fit for purpose for the subject and level, and should fit in with learning and teaching approaches.

Unit assessment should support learning and teaching and, where possible, enable personalisation and choice for learners in assessment methods and processes. Teachers and lecturers should select the assessment methods they believe are most appropriate, taking into account the needs of their learners and the requirements of the Unit.

There is no mandatory order for delivery of the Outcomes. These should be overtaken throughout the Unit and are an integral part of learning and teaching.

The table below gives guidance and advice on possible approaches to assessment and gathering evidence:

Strategies for gathering evidence
There may be opportunities in the day-to-day delivery of the Units in a Course to observe learners providing evidence, which satisfies completely, or partially, a Unit or Units. This is naturally occurring evidence and can be recorded as evidence for an Outcome or parts of an Outcome. In some cases, additional evidence may also be required to supplement and confirm the naturally occurring evidence. Approaches to assessment might cover the whole Unit or be combined across Outcomes. A holistic approach can enrich the assessment process for the

learner by bringing together different Outcomes and/or Assessment Standards. If a holistic approach is used, then it is necessary to be able to track individual Assessment Standard evidence.

Strategies for gathering evidence and ensuring that the learners' work is their own could include:

- personal interviews during which the teacher or lecturer can ask additional questions about completed work
- an oral presentation on their work
- writing reports in supervised conditions
- checklists to record the authenticity
- supplementary sources of evidence, such as witness testimony, film or audio clips

Evidence can be gathered from classwork, experiments, investigations and/or research carried out in this Unit. It can be obtained using one or more of the strategies outlined above or by alternative methods, which could include a test of knowledge, understanding and skills.

Combining assessment within Units

See *Course Support Notes*.

Equality and inclusion

The *Course Support Notes* provide full information on equality and inclusion for this Unit.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Unit Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

Alternative approaches to Unit assessment to take account of the specific needs of learners can be used. However, the centre must be satisfied that the integrity of the assessment is maintained and that the alternative approaches to assessment will, in fact, generate the necessary evidence of achievement.

Appendix 1: Reference documents

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- Course Specifications
- Design Principles for National Courses
- *Guide to Assessment* (June 2008)
- Principles and practice papers for curriculum areas
- Science: A Portrait of current practice in Scottish Schools (2008)
- Research Report 4 — Less is More: Good Practice in Reducing Assessment Time
- Coursework Authenticity — a Guide for Teachers and Lecturers
- *SCQF Handbook: User Guide* (published 2009) and SCQF level descriptors (to be reviewed during 2011 to 2012): www.sqa.org.uk/sqa/4595.html
- *SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work*
- SQA Guidelines on e-assessment for Schools
- SQA Guidelines on Online Assessment for Further Education
- SQA e-assessment web page: www.sqa.org.uk/sqa/5606.html

Administrative information

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History of changes to Course Support Notes

Course details	Version	Description of change	Authorised by	Date
	2.0	Page 46 - Key areas changed	Qualifications Development Manager	June 2014

Unit Support Notes

Unit Support Notes — Environmental Science: Sustainability (Higher)

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

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Environmental Science: Sustainability (Higher) Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- the *Unit Specification*
- the *Course Specification*
- the *Course Assessment Specification*
- the *Course Support Notes*
- appropriate assessment support materials

General guidance on the Unit

Aims

The general aim of this Unit is to develop skills of scientific inquiry, investigation and analytical thinking, along with knowledge and understanding sustainability.

Learners will apply these skills when considering the applications of sustainability on our lives, as well as the implications on society/the environment. This can be done by using a variety of approaches, including investigation and problem solving.

The Unit covers the key areas of:

- food
- water
- energy
- waste management

Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Progression into this Unit

Entry to this Unit is at the discretion of the centre.
However, learners would normally be expected to have attained the skills, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- National 5 Environmental Science Course

There may also be progression from National 5 Biology Course or National 5 Geography.

Skills, knowledge and understanding covered in this Unit

Information about skills, knowledge and understanding is given in the Environmental Science Higher *Course Support Notes*.

If this Unit is being delivered on a free-standing basis, teachers and lecturers should cover the mandatory skills and key areas in ways which are most appropriate for delivery in their centres.

Progression from this Unit

This Unit may provide progression to:

- other qualifications in Environmental Science or related areas
- further study, employment and/or training

Approaches to learning, teaching and assessment

Approaches to learning and teaching and suggested learning activities are covered in the *Course Support Notes*.

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

Information about developing skills for learning, skills for life and skills for work in this Unit, is given in the relevant *Course Support Notes*.

Learners are expected to develop broad generic skills as an integral part of their learning experience. The *Unit Specification* lists the skills for learning, skills for life and skills for work that learners 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 Unit where there are appropriate opportunities. The level of these skills will be appropriate to the level of the Unit. Information about developing skills for learning, skills for life and skills for work in this Unit, is given in the relevant *Course Support Notes*.

Approaches to assessment and gathering evidence

The purpose of this section is to give advice on approaches to assessment for the Unit. There will be other documents produced for centres to provide exemplification of assessments and guidance on how to write them.

Approaches to the assessment of a Unit when it forms part of a Course may differ from approaches to assessing the same Unit when it is not being delivered as part of a Course. If an integrated approach to Course delivery is chosen, then there may be opportunities for combining assessment across Units.

Assessments must be valid, reliable and fit for purpose for the subject and level, and should fit in with learning and teaching approaches.

Unit assessment should support learning and teaching and, where possible, enable personalisation and choice for learners in assessment methods and processes. Teachers and lecturers should select the assessment methods they believe are most appropriate, taking into account the needs of their learners and the requirements of the Unit.

There is no mandatory order for delivery of the Outcomes. These should be overtaken throughout the Unit and are an integral part of learning and teaching.

The table below gives guidance and advice on possible approaches to assessment and gathering evidence:

Strategies for gathering evidence

There may be opportunities in the day-to-day delivery of the Units in a Course to observe learners providing evidence, which satisfies completely, or partially, a Unit or Units. This is naturally occurring evidence and can be recorded as evidence for an Outcome or parts of an Outcome. In some cases, additional evidence may also be required to supplement and confirm the naturally occurring evidence.

Approaches to assessment might cover the whole Unit or be combined across Outcomes. A holistic approach can enrich the assessment process for the learner by bringing together different Outcomes and/or Assessment Standards. If a holistic approach is used, then it is necessary to be able to track individual Assessment Standard evidence.

Strategies for gathering evidence and ensuring that the learners' work is their own could include:

- personal interviews during which the teacher or lecturer can ask additional questions about completed work
- an oral presentation on their work
- writing reports in supervised conditions
- checklists to record the authenticity
- supplementary sources of evidence, such as witness testimony, film or audio clips

Evidence can be gathered from classwork, experiments, investigations and/or research carried out in this Unit. It can be obtained using one or more of the strategies outlined above or by alternative methods, which could include a test of knowledge, understanding and skills.

Combining assessment within Units

See *Course Support Notes*.

Equality and inclusion

The *Course Support Notes* provide full information on equality and inclusion for this Unit.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Unit Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

Alternative approaches to Unit assessment to take account of the specific needs of learners can be used. However, the centre must be satisfied that the integrity of the assessment is maintained and that the alternative approaches to assessment will, in fact, generate the necessary evidence of achievement.

Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- Assessment Arrangements (for disabled learners and/or those with additional support needs) — various publications on SQA's website: http://www.sqa.org.uk/sqa/14976.html
- *Building the Curriculum 3: A framework for Learning and Teaching*
- *Building the Curriculum 4: Skills for learning, skills for life and skills for work*
- *Building the Curriculum 5: A framework for assessment*
- *Course Specifications*
- Design Principles for National Courses
- *Guide to Assessment (June 2008)*
- Principles and practice papers for curriculum areas
- Science: A Portrait of current practice in Scottish Schools (2008)
- Research Report 4 — Less is More: Good Practice in Reducing Assessment Time
- Coursework Authenticity — a Guide for Teachers and Lecturers
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