GCE

AS and A Level Specification

Environmental Studies

AS exams 2009 onwards
A2 exams 2010 onwards

Contents

Vertical black lines indicate a significant change or addition to the previous version of this specification.

1 Introduction

1.1 Why choose AQA?

It's a fact that AQA is the UK's favourite exam board and more students receive their academic qualifications from AQA than from any other board. But why does AQA continue to be so popular?

- **Specifications**

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If you are an existing customer then we thank you for your support. If you are thinking of moving to AQA then we look forward to welcoming you.

1.2 Why choose Environmental Studies?

The Environmental Studies specification enables students to gain a deep and well-informed insight into the environment, and the scientific processes that control and affect it. The central theme is the development of an understanding of how different events and cycles within the environment interrelate, how they influence subsequent environmental events, the human impacts on these events and cycles, and the strategies that can be used to minimise the problems caused. Key aspects within the specification include areas such as 'Wildlife Conservation', 'Pollution', 'Global Climate Change' and 'Sustainability'.

This is a complete revision of the AQA GCE Environmental Science specification. It retains many features of the current specification, but has been updated and re-named to reflect current environmental issues. It represents a coherent and consistent development from the AQA GCSE Environmental Science specification and develops further the thematic approach to environmental studies. The content of the previous specification has been reviewed and repackaged, with some aspects, which were mainly pure biology, chemistry, physics or geography, omitted or reduced in amount. In all cases sufficient scientific knowledge is developed to allow a full understanding of subsequent environmental topics.

Students are not required to submit an internally assessed environmental studies investigation. However, it is expected that candidates should carry out investigative activities, appropriate to the study of a range of environmental systems and the way in which they influence and affect each other. They should carry out extensive, appropriate practical work, both within the laboratory and, wherever possible, out in the environment. Integral to each unit is the development and use of practical skills relevant to the study of the environment; these will be assessed within each unit. Included in these assessments will be the planning and carrying out of investigations, the interpretation of data and the comprehension of relevant environmental texts.

This specification builds from the knowledge gained in a range of GCSE science subjects, including GCSE Environmental Science, although its study is not essential to undertake the A Level course. As part of a group of science or arts A Level courses, Environmental Studies provides an ideal base for employment, a range of vocational qualifications and a very wide variety of higher education courses, including degrees in areas related to the environment, geography, geology, science, climate, planning and teaching.

1.3 How do I start using this specification?

Already using the existing AQA Environmental Studies specification?

- Register to receive further information, such as mark schemes, past question papers, details of teacher support meetings, etc, at **http://www.aqa.org.uk/rn/askaqa.php** Information will be available electronically or in print, for your convenience.
- Tell us that you intend to enter candidates. Then we can make sure that you receive all the material you need for the examinations. This is particularly important where examination material is issued before the final entry deadline. You can let us know by completing the appropriate Intention to Enter and Estimated Entry forms. We will send copies to your Exams Officer and they are also available on our website **http://www.aqa.org.uk/admin/p_entries.html**

Not using the AQA Specification currently?

- Almost all centres in England and Wales use AQA or have used AQA in the past and are approved AQA centres. A small minority are not. If your centre is new to AQA, please contact our centre approval team at **centreapproval@aqa.org.uk**

1.4 How can I find out more?

Ask AQA

You have 24-hour access to useful information and answers to the most commonly-asked questions at **http://www.aqa.org.uk/rn/askaqa.php**

If the answer to your question is not available, you can submit a query for our team. Our target response time is one day.

Teacher Support

Details of the full range of current Teacher Support meetings are available on our website at **http://www.aqa.org.uk/support/teachers.html**

There is also a link to our fast and convenient online booking system for Teacher Support meetings at **http://events.aqa.org.uk/ebooking**

If you need to contact the Teacher Support team, you can call us on 01483 477860 or email us at **teachersupport@aqa.org.uk**

2 Specification at a Glance

AS Examinations

AS Award 1441

Unit 1 – ENVS1
The Living Environment

Written unit 1 hour — 60 marks; 40% of the total AS marks; 20% of the total A Level marks

This unit comprises **five** short answer questions (45 marks) and **one** structured question (15 marks).

All questions are compulsory.

Available January and June

Unit 2 – ENVS2
The Physical Environment

Written unit 1½ hours — 90 marks; 60% of the total AS marks; 30% of the total A Level marks

This unit comprises **eight** short answer questions (75 marks) and **one** structured question including extended prose (15 marks).

All questions are compulsory.

Available January and June

A2 Examinations

A Level Award 2441

Unit 3 – ENVS3
Energy Resources and Environmental Pollution

Written unit 1½ hours — 80 marks; 25% of the total A Level mark

This unit comprises **seven** compulsory short answer/structured/comprehension questions (60 marks) and **one** essay from a choice of three titles (20 marks).

Includes synoptic assessment.

Available in June only

Unit 4 – ENVS4
Biological Resources and Sustainability

Written unit 2 hours — 80 marks; 25% of the total A Level mark

This unit comprises **five** compulsory short answer/structured/comprehension questions (45 marks), **one** compulsory data analysis question (15 marks) and **one** essay from a choice of three titles (20 marks).

Includes synoptic assessment.

Available in June only

AS + A2 = A Level

3 Subject Content

Summary of Subject Content

Unit 1 The Living Environment

An introduction to the biodiversity of life on Planet Earth.

The reasons why the conservation of life on Earth is important are investigated, as are the methods which may be used to achieve effective conservation. Conservation in the UK, coral reefs, Antarctica and tropical rainforests are used to develop these issues further.

'Life Processes in the Biosphere' allows consideration of the ecological relationships between organisms and their abiotic and biotic environments in order to understand conservation problems further and how these may be managed.

Unit 2 The Physical Environment

Physical resources such as atmospheric gases, water and mineral nutrients are essential for life on Earth.

Humans exploit and manage physical resources to provide higher material living standards.

The use of many of these resources is unsustainable.

Unit 3 Energy Resources and Environmental Pollution

Future problems of energy supply and how these may be resolved are investigated through the study of the energy resources which are available for use.

The properties of pollutants are considered to explain why some materials or forms of energy cause environmental damage. These issues are developed through the study of a range of atmospheric, aquatic and terrestrial pollutants. The strategies which may be used to minimise releases, treat effluents and manage the damage caused are considered. These issues allow consideration of the issues related to Units 1 and 2 which involve pollution.

Unit 4 Biological Resources and Sustainability

The factors controlling human population growth are considered in relation to the demands placed upon the planet's resources and life-support systems.

Food production and forestry systems are analysed, with particular emphasis on the limiting factors affecting productivity, the environmental problems caused by these systems and the ways in which problems can be addressed.

The study of the sustainability of human lifestyles allows synoptic consideration of the other modules of the specification.

3.1 Unit 1 ENVS1 The Living Environment

An introduction to the biodiversity of life on Planet Earth.

The reasons why the conservation of life on Earth is important are investigated, as are the methods which may be used to achieve effective conservation. Conservation in the UK, coral reefs, Antarctica and tropical rainforests are used to develop these issues further.

'Life Processes in the Biosphere' allows consideration of the ecological relationships between organisms and their abiotic and biotic environments in order to understand conservation problems further and how these may be managed.

3.1.1 Conditions for Life on Earth

Topic Titles	Main Issues	Details
The main conditions which allow life to survive on Planet Earth	Suitable abiotic factors	Availability of water Appropriate temperature range Suitable ambient gases Light
How the presence of life on Earth has brought about environmental change	Atmospheric change	Atmospheric oxygen and ozone Atmospheric carbon dioxide and temperature control

3.1.2 Wildlife Conservation

Topic Titles	Main Issues	Details
The rationale for wildlife conservation	Educational reasons Aesthetic/ recreational reasons Moral reasons Economic benefits	Medical • physiological research • the development of medicines Food resources • domestication of new species • wild varieties for breeding programmes • the use of species for biological control Other materials • timber • resins • fibres • cosmetics • fuels

3.1.2 Wildlife Conservation (continued)

	Earth's life-support systems which involve living organisms	• maintenance of the atmosphere • nutrient cycling • the role of plants in the hydrological cycle • soil formation and conservation
	Species interdependence	The survival of many species relies upon the services which are provided by other species • food supplies • pollination • seed dispersal • habitat provision
How humans threaten wildlife	Deliberate exploitation	• food • fashion • entertainment • furniture and ornaments • traditional medicines • other products
	Accidental harm from human activities	• fishing by-catch • farm harvesting • roadkill
	Introduced species	• predators • competitors • disease
	Deliberate eradication of species	• predators • competitors
	Habitat change	The particular habitat requirements of species and their inability to survive change Competitor species may be better able to survive the changes. Examples of particular adaptations may be used from 'Adaptation to the Environment' (3.3.1).
	Habitat destruction	• deforestation • expansion of farmland • urbanisation • mineral extraction • flooding by reservoirs

3.1.2 Wildlife Conservation (continued)

Conservation methods	**Legal protection**	
	Trade controls	CITES (Convention on International Trade in Endangered Species)
	Laws which ban damaging activities	The Wildlife & Countryside Act (1981 & 1984)
	Laws enabling the establishment of protected areas	The Wildlife & Countryside Act (1981 & 1984)
	Sustainable exploitation	IWC (International Whaling Commission)
	Captive breeding and release programmes	Problems keeping some species in captivity Captive breeding problems and methods to increase success Problems with release programmes and methods to increase success
	Habitat conservation	
	Habitat protection	Establishment of nature reserves to reduce disturbance or damage
	Habitat management	To maintain or enhance a habitat • control of succession • culling or removing undesirable species • provision of suitable conditions • biological corridors to link habitats
	Habitat creation	Alteration of unsuitable habitats so that desired species can survive
Conservation in the UK	The role of government organisations in protecting sites of ecological importance	Designation of protected areas by Natural England, Countryside Council for Wales or equivalent
	UK designations	• Sites of Special Scientific Interest (SSSIs) • National Nature Reserves • Local Nature Reserves • Marine Nature Reserves
	International designations	• Ramsar sites • Special Protection Areas (SPAs) • Special Areas of Conservation (SACs)
	Agri-environmental systems	The Single Farm Payment replaces previous schemes such as Environmentally Sensitive Areas (ESA) and the Countryside Stewardship Scheme (CSS) with the Environmental Stewardship Scheme (ESS).
	The role of voluntary organisations and pressure groups	• World Wide Fund for Nature (WWF) • Royal Society for the Protection of Birds (RSPB)

3.1.2 Wildlife Conservation (continued)

UK habitats	Introduction to UK habitats	The influence of human activities in producing semi-natural habitats in the UK, many being plagioclimaxes. Management practices include • farming – grazing, field boundary maintenance • hunting and fishing – maintenance of cover, moorland burning, river management • woodland management – coppicing, pollarding
	Threatened habitats in the UK	The activities and land use changes which threaten natural and traditional habitats and landscapes and the use of suitable examples to illustrate these • habitat destruction to change land use • changes in management practices One UK habitat should be studied to understand the main controlling ecological features, eg broadleaf woodland, lowland heathland, chalk grassland or other suitable example.
Conservation abroad		The main ecological features, importance to humans, threats and conservation efforts for the following • tropical rainforest • coral reefs • Antarctica

3.1.3 Life Processes in the Biosphere

Topic Titles	Main Issues	Details
Adaptation to the environment	To survive, all species must be well adapted to their physical and biological environment	Range of tolerance Species' adaptations affect their ability to survive environmental change and influence management practices in habitats protected for wildlife.
Abiotic and biotic factors	Abiotic factors	The distribution of species is controlled by abiotic factors. This knowledge can guide habitat management to make conditions more suitable. Suitable examples should be used (from habitats studied elsewhere in the specification if possible).
	Species interdependence and abiotic factors	The abiotic factors which affect a species may be controlled or modified by other species living in the same habitat.
	Biotic factors	The distribution of species is controlled by biotic factors. Suitable examples should be used (from habitats studied elsewhere in the specification if possible).

3.1.3 Life Processes in the Biosphere (continued)

	Species interdependence and biotic factors	Species interdependence often requires conservation of communities of species rather than individual species • the roles and interaction of decomposers and detritivores in decomposition and recycling nutrients • food supplies • pollination • seed dispersal • habitat provision
Grouping organisms	Organisms can be categorised in many ways that help the understanding of their roles and interrelations	• species • population • community • ecosystem • habitat • niche • biome • biosphere
Changes in ecosystems	An understanding of natural changes helps in the understanding of the impact of human activities and to influence conservation strategies	
	Ecological succession	A lithosere and hydrosere should be used to illustrate the following • the seral stages from first colonisation to the climax community • the major changes in abiotic factors • the general types of organisms present and their adaptations • the influence of climatic, edaphic (soil) and biotic (including anthropogenic) factors on the rate and direction of seral change • changes are slower if the abiotic conditions are less suitable for life • the climax community produced is controlled by the climate and soil type • human activities may deflect succession and produce plagioclimaxes

3.1.3 Life Processes in the Biosphere (continued)

	Diversity and ecological stability	The assessment of species diversity is important in monitoring environmental change, damage and the success of conservation efforts. Species diversity in the context of ecological stability Low species diversity in extreme environments dominated by abiotic factors, in which populations may fluctuate dramatically Higher diversity in less hostile environments resulting in more stable populations, in which populations are dominated by biotic factors Estimates of the total number of species that exist and how these are made
Populations	Population dynamics	An understanding of population dynamics is important in monitoring species' survival, breeding success and in assessing the Maximum Sustainable Yields of exploited species
	Population regulation	An understanding of how reproduction, mortality and migration control population size
	Homeostatic regulation of population size	How density-dependent factors control population size Carrying capacity

3.1.4 Land Resources

Topic Titles	Main Issues	Details
The conservation of landscape for informal public enjoyment	The landscape may be conserved for informal public enjoyment	Since communities of plants and associated animals are an important part of the landscape, landscape conservation often results in wildlife conservation.
The enhancement of the environment for amenity use and the organisations involved	Landscape protection Landscape enhancement Visitor management	Maintenance of features that are natural or have been produced by human activities and give the countryside its character Restoration and development of countryside features to enhance its character The provision of facilities without damaging the character of the countryside
Governmental organisations	Natural England/ Countryside Council for Wales or equivalent Local authorities (and others) DEFRA (or equivalent)	The purposes of National Parks and AONBs (Areas of Outstanding Natural Beauty) Country Parks Environmental Stewardship Scheme – Entry Level and Higher Level
Non-governmental organisations		The National Trust

3.1.4 Land Resources (continued)

Land-use conflicts Causes of land-use conflicts	The competition for land resources in the UK	Conflicts involving competing, adjacent or multiple land uses and therefore impacts upon the environment
	Urban expansion	
	Transport developments	• new/enlarged roads • new/enlarged airports • port developments
	Mining/quarrying	
	Harnessing energy	• windfarms • tidal barrages • power stations
	Recreation and tourism	
	Waste disposal	• landfill sites • incinerator location
Methods of resolving land-use conflicts	Legislative methods	
	Statutory planning controls and restrictions	Planning applications are granted if they are appropriate within local and national planning strategies of the local planning authority and the government.
	Areas with very strict planning controls	• National Parks • Green Belts
	Public Inquiries	When there is disagreement and for all large developments
Impact assessment	Environmental Impact Assessment (EIA)	Ensure that environmental impacts are considered in the planning process Use of the Leopold matrix
Land-use zoning	Space zoning	Allocation of different areas for activities that would conflict
	Time zoning	Allocation of different time periods for activities that would conflict
Economic methods	Pricing mechanisms	Cost benefit analysis

3.1.5 Practical Skills

Practical skills	Candidates should have first-hand experience of measuring the following features of the biosphere	
	Diversity and ecological stability	Species diversity in the context of ecological stability Calculation of an index from the formula: $D = \frac{N(N-1)}{\sum n(n-1)}$ where N = total number of organisms of all species and n = total number of organisms of a particular species Candidates should study appropriate examples drawn from fieldwork as far as possible
	Measurement of population size and density	Candidates should have first-hand experience of • methods used for measurement of populations • random sampling using quadrats to estimate species frequency • measuring species density and percentage cover • use of belt transects to record changes in species distribution • use of abundance scales and their limitations
	Assessment of various habitats and biotic factors	Methods and their limitations for the collection of aquatic, airborne and soil-dwelling organisms • the mark-release-recapture (Lincoln Index) method of estimating population size using the formula: $\frac{n_1 \times n_2}{n_m}$ and an understanding of the assumptions made in the use of the technique • kick sampling and nets for aquatic organisms • pitfall traps, pooters, sweep nets and beating trays for organisms in air or vegetation • light traps for night-flying moths • Tüllgren funnels for soil and litter organisms • extraction of earthworms from soil

3.2 Unit 2 ENVS2 The Physical Environment

Physical resources such as atmospheric gases, water and mineral nutrients are essential for life on Earth.

Humans exploit and manage physical resources to provide higher material living standards.

The use of many of these resources is unsustainable.

3.2.1 The Atmosphere

Topic Titles	Main Issues	Details
The composition of the atmosphere	A consideration of the composition of the atmosphere and the processes which influence life on Earth The normal percentages of the main gases in the atmosphere Changes with altitude in the troposphere and stratosphere	• ozone concentration • temperature • atmospheric pressure The processes that cause the composition of the atmosphere to fluctuate The importance of the atmosphere as a life-support system: a source of oxygen, carbon dioxide and nitrogen for living organisms, and water vapour for the hydrological cycle The role of the ozone 'layer' in reducing ultraviolet light levels at the Earth's surface. The dynamic equilibrium involving the different forms of oxygen
The structure of the atmosphere	The most significant layers for life on Earth being the troposphere and the stratosphere	
Solar radiation and the atmosphere	The process of nuclear fusion as it occurs in the Sun The wave nature of electromagnetic radiation and the electromagnetic spectrum The characteristics of insolation and factors which cause it to change	The joining of nuclei of hydrogen/helium with the release of energy Wavelength characteristics, and the environmental importance of ultraviolet, visible and infra red light • at the outer limits of the atmosphere • as it passes through the atmosphere • when it reaches the Earth's surface

3.2.1 The Atmosphere (continued)

Global climate change	The Greenhouse Effect	The Greenhouse Effect as a natural phenomenon The dynamic equilibrium of energy inputs and losses
	Enhanced Greenhouse Effect and global climate change	The role of atmospheric gases in maintaining the heat balance and global climate of the Earth The gases which may contribute to global climate change include carbon dioxide, methane, chlorofluorocarbons (CFCs), oxides of nitrogen and low level (tropospheric) ozone The major anthropogenic sources, changing concentrations and relative effects of these gases
	The likely consequences of global climate change	• sea level rise due to expansion of water and melting of land ice • change in wind patterns • change in rainfall patterns • change in ocean currents including El Niño and the Gulf Stream/North Atlantic conveyor The consequential changes in species distribution and the extinction of species that cannot colonise new habitats The difficulties of predicting global climate change
	Feedback mechanisms	The possible negative and positive feedback mechanisms that could decrease or increase the rate and pattern of global climate change
	Control of global climate change	
	Attempts to reduce emissions of greenhouse gases	Reference to recent relevant international conventions • Kyoto 1997
	Methods of reducing the release of greenhouse gases	Candidates should be able to describe methods of reducing levels of carbon dioxide, methane, oxides of nitrogen, CFCs, tropospheric ozone.
	Strategies to cope with climate change	• changes in lifestyle • infrastructure • land use
Ozone depletion	UV light absorption and depletion of the ozone layer	
	The effects of ultraviolet light on living organisms	Skin damage, skin cancer, cataracts and damage to plant tissue
	The protective role of the 'ozone layer' (ozonosphere)	The absorption of UV and its conversion to chemical energy in reactions involving the various forms of oxygen
	The role of pollutant gases	For example halogens (especially chlorine) on ozone depletion and the major sources of these gases

3.2.1 The Atmosphere (continued)

	The methods by which CFC emissions may be reduced	• international agreements such as the 'Montreal Protocol' • replacement materials • alternative processes or methods • the effect of these methods on the seriousness of ozone depletion • the impact of action taken to reduce CFC emissions on rate of ozone depletion

3.2.2 The Hydrosphere

Topic Titles	Main Issues	Details
The hydrosphere contains water in all its forms (solid, liquid, vapour) which may be found on, in and around the Earth		
Properties of water	Environmentally significant properties of water	• changes of state between solid, liquid and gas • anomalous expansion near freezing point • solvent properties • high heat capacity
The hydrological cycle	The reservoirs of water in the hydrological cycle	Oceans, ice, lakes and rivers, atmosphere, groundwater, soil moisture, living organisms
	Residence times and transfers between reservoirs	The calculation of residence time using the formula: RT = volume/mean transfer rate An understanding of this helps in the management of water resources
	The main processes involved in the hydrological cycle	Inputs – precipitation Transfers – interception, infiltration, throughflow, percolation, groundwater, runoff Ouputs – evaporation, transpiration, river channel discharge
	Sources of energy driving the hydrological cycle	The important energy sources driving the cycle • solar radiation/insolation • gravity/potential energy

3.2.2 The Hydrosphere (continued)

Water as a resource		
Uses of water	Abstractive uses	Domestic, industrial and agricultural uses Physical, chemical and biological criteria for assessing water quality for public supply and their relative merits • turbidity • pH • calcium content • pesticide and heavy metal concentrations • dissolved O_2 • Cl_2 retention • *E.coli* abundance
	Non-abstractive uses	• recreation • wildlife conservation in wetlands • energy • transport Study of these uses should include the associated problems and conflicts of interest and methods used to resolve these conflicts.
Sources of water	The effect of water availability on domestic, agricultural and industrial activities	
	The major possible sources: rivers, reservoirs, seawater, aquifers	The difficulties caused by the relative shortages of good locations for water abstraction and use
	Rivers	
	Factors affecting the suitability of rivers as sources of water	• volume • supply fluctuations • quality
	Environmental effects of abstraction of river water	Excessive abstraction causes • reduced downstream flow • increased sedimentation • reduced water levels, including lakes fed by the river

3.2.2 The Hydrosphere (continued)

	Reservoirs Reservoir location	The best hydrological sites for reservoirs are often those that have greatest value for scenery and wildlife. This makes the decision-making process difficult. Factors which reduce the number of suitable sites for reservoirs • topography • geology • catchment area • water supply volume • flow fluctuations • existing land use • pollution risk • sedimentation • infrastructure
	Environmental effects of reservoirs	Changes in sedimentation in the reservoir and downstream Microclimate • reduced temperature fluctuations • higher windspeed downwind • higher humidity downwind Changed river regime downstream of reservoirs - flow fluctuations, temperature, turbidity Habitat change • flooding of reservoir site • division of river length producing a barrier to migration/ dispersal
	Aquifers	Properties of suitable rocks and locations • porosity • permeability • suitable geological structures to retain water • lack of conflicts with surface land uses
	Consequences of overuse	The need to abstract no more than the recharge rate The effects of over-abstraction, including • lowered water table • subsidence • drying of wetlands • vegetation change • salinisation
	Seawater	Desalination of seawater is very energy-intensive and expensive and is only used in countries with inadequate freshwater supplies where seawater is available.

3.2.2 The Hydrosphere (continued)

Water treatment	Processes involved in water treatment	Candidates should be able to outline the treatment processes used to produce water of potable (drinkable) quality.
	Freshwater	• sedimentation • flocculation • filtration • activated carbon filtration • aeration • chlorination • ozonation • ultraviolet light treatment • fluoridation
	Seawater	Desalination of seawater by reverse osmosis and distillation
Demand for water	Trends in water demand and the spatial and temporal mismatch of supply of and demand for water	The causes of changes in regional demand Changes in population size, living standards, amount of industry, types of industry A comparison of per capita demand for water in More Developed and Less Developed Countries and the problems caused by water shortages
Water conservation and management	The methods used to make better use of the available water resources	An outline of the strategies for providing adequate supplies and how each strategy can increase supplies or increase usability of existing supplies
	Increased abstraction	Surface storage reservoirs, artificial recharge of aquifers, desalination of seawater, estuarine barrages, interbasin transfer
	Reduced use	Conservation and recycling of water, grey water use, metering, domestic appliances with lower water consumption, leakage control by better maintenance
	Increased availability	Reducing pollution of potential sources: control of agrochemical use, sewage treatment, control of industrial effluent

3.2.3 The Lithosphere

Topic Titles	Main Issues	Details
The lithosphere consists of the solid resources of the crust	The natural processes affecting the distribution and availability of exploitable rocks, minerals and elements in biogeochemical cycles are investigated and are developed further through a study of their human use and the strategies to maximise their future availability	
		Unsustainable exploitation of these resources can result in • the exhaustion of reserves • the increased production of harmful waste • land degradation • a lower quality of life for current and future generations The composition of soils is considered to allow an understanding of how they may be analysed. The importance of soils is expanded in Unit 4.
Mineral Resources	The most important mineral resources	Fossil fuels, metal ores, non-metal minerals
The geological origins of economically important minerals	If all the minerals in the crust were evenly mixed then none of them would be sufficiently concentrated to allow exploitation	Geological processes have provided local concentrations that can be exploited.
	Igneous processes Sedimentary processes	• granite batholiths • hydrothermal metal ore deposits • alluvial/placer deposits – sand, gravel • evaporites – salt • biological deposits – fossil fuels, limestone

3.2.3 The Lithosphere (continued)

	Metamorphic processes	• slate • marble
Reserves, resources and exploitation	Minerals are non-renewable resources	The amounts that exist are finite, although most are very abundant. The main limitations to mineral availability are • location • chemical form • purity • availability of suitable technologies
	Resources and reserves	The differences between 'resources' and 'reserves' in terms of quantity and exploitability
	Sources and demand	Factors affecting the viability of exploiting mineral deposits • mining costs • processing costs • chemical form of mineral • purity • land costs and conflicts • transport costs • market economics including cut-off grade
	The environmental impacts of mineral exploitation	The main environmental impacts of mining, quarrying and dredging, and some methods used to reduce these • exploration: marine seismic surveys, exploration on land • land take: conflicts with existing land use • habitat loss: loss of species • loss of amenity: aesthetic problems for local community • air and water pollution: dust, noise, turbid drainage water, toxic leachate • spoil disposal: spoil instability • subsidence: caused by poor spoil compaction or undermining • transport nuisance: noise, fumes, dust, traffic accidents • flooding by drainage water • ore processing: the disposal of solid wastes

3.2.3 The Lithosphere (continued)

	Reduction of environmental impacts	The methods used to reduce some of the problems identified above • landscaping • water sprays • baffle mounds/embankments • sedimentation lagoons • leachate collection • acid neutralisation • spoil compaction • transport type choice, routing, timing
	The future of mineral supplies	Minerals are non-renewable resources and reserves are finite.
	Methods used to extend the time period of exploitation	• more exploration • better exploratory techniques such as remote sensing • better/more mechanised mining techniques • use of low-grade ores • recycling • material substitution
Biogeochemical cycles	The common features of biogeochemical cycles	The concept that the cycling of elements, including plant nutrients, occurs between the gaseous, hydrological, sedimentary and biological reservoirs with varying residence times. They are partly driven by solar energy. An understanding of these cycles aids the management of nutrient supply systems.
The carbon cycle	The main reservoirs of carbon	In the atmosphere: mainly as carbon dioxide In water: mainly as dissolved carbon dioxide and hydrogen carbonate ions In plants, animals and dead organic matter: mainly as carbohydrates, lipids and proteins In carbonaceous rocks (eg limestone): mainly as calcium carbonate In fossil fuels: mainly as carbon and hydrocarbons
	The physical, chemical and biological processes involved in moving carbon between the reservoirs in the carbon cycle	• photosynthesis • respiration • food chains • sedimentation • fossilisation • combustion • decomposition
	Dynamic equilibria and factors affecting them	The concept of dynamic equilibria produced by active processes which produce an overall balance by cancelling out the changes they cause The Gaia hypothesis which regards the planet as a self-regulating system that resists change

3.2.3 The Lithosphere (continued)

	The effects of human activities on the carbon cycle and the environmental significance of these changes	Fossil fuel combustion, deforestation, livestock, soil disturbance, effect of global climate change on decomposition and photosynthesis
The nitrogen cycle	The main reservoirs of nitrogen	In the atmosphere: mainly as gaseous nitrogen, with some oxides of nitrogen In plants: mainly as proteins In animals: mainly as proteins In dead organic matter: mainly as proteins which break down to release ammonium compounds In soil: as nitrates, nitrites and ammonium compounds In water: as dissolved nitrates and ammonium compounds In rocks: in minerals containing nitrogen
	The physical, chemical and biological processes involved in moving nitrogen between the reservoirs in the nitrogen cycle	• ionisation • fixation • food chains • nitrification • denitrification • leaching • absorption by roots
	Human activities affecting the nitrogen cycle	The effects of human activities on the nitrogen cycle • manufacture and use of nitrate fertilisers • agriculture drainage, soil disturbance and their effects on nitrogen fixation, denitrification, nitrification and decomposition, growth of legumes, eg peas and beans • pollution – release of NO_x
The phosphorus cycle	The main reservoirs of phosphorus	In plants and animals in proteins, bone and ATP In sediments and rocks as calcium phosphate In water as dissolved phosphates produced by the weathering of rock (most are relatively insoluble)
	The physical, chemical and biological processes involved in moving phosphorus between the reservoirs in the phosphorus cycle	• absorption by roots • food chains • decomposition • sedimentation • mountain building • weathering The low solubility of phosphates and the absence of a gaseous reservoir often makes the availability of phosphorus the limiting factor on plant growth.

3.2.3 The Lithosphere (continued)

	The effects of human activities on the phosphorus cycle	Use of phosphate fertilisers to increase yields Eutrophication: the rapid growth and subsequent decay of aquatic vegetation caused by effluents rich in phosphates and nitrates
Soils	Soil and its properties have a major impact on plant survival in both natural and agricultural habitats. All nutrients in biogeochemical cycles pass through the soil.	
	The components of soils	The components of soil and how each affects the properties of soil • mineral skeleton – texture (sand, silt, clay) • air • water • living organisms • organic matter including humus
	The effect of soil properties on soil fertility and productivity	Aeration Water drainage, infiltration and retention Thermal capacity Structure (crumb, blocky, platy peds)

3.2.4 Practical Skills

Practical skills	Candidates should have first-hand experience of soil analysis methods	Soil analysis including texture (particle size of sand, silt, clay), organisms, pH, water content and organic matter. Candidates should be able to identify soil types using a soil triangle.

3.3 Unit 3 ENVS3 Energy Resources and Environmental Pollution

Future problems of energy supply and how these may be resolved are investigated through the study of the energy resources which are available for use.

The properties of pollutants are considered to explain why some materials or forms of energy cause environmental damage. These issues are developed through the study of a range of atmospheric, aquatic and terrestrial pollutants. The strategies which may be used to minimise releases, treat effluents and manage the damage caused are considered. These issues allow consideration of the issues related to Units 1 and 2 which involve pollution.

The study of technical detail should be limited to aspects that increase the environmental understanding of these issues

3.3.1 Energy

Topic Titles	Main Issues	Details
Energy use	Factors affecting energy use now and in the future	The main factors which influence per capita energy consumption in different countries • affluence • level and type of industry • climate • environmental awareness The importance of energy availability and consumption in controlling development and quality of life
Energy resources	The concept of non-renewable and renewable primary fuels	The advantages and disadvantages of non-renewable and renewable resources in terms of their application to particular uses, their environmental impacts and future availability The importance of sustainable use of those renewable resources that can be depleted
Non-renewable energy resources		The use of examples to illustrate the factors affecting the ease of use of non-renewable energy resources and therefore their likely use in the future
	Finite resources	The depletion of fossil fuel reserves
	Energy density	• high energy density of fossil fuels and their use as vehicle fuels and to achieve high temperatures on combustion • the very high density of nuclear fuels and the low fuel requirement of nuclear reactors • the low energy density of most renewable energy resources
	Available resource	The amounts of fossil and fissile fuels that exist are very large but much cannot be exploited.
	Level of technological development	Technological problems make exploitation of some resources difficult. • the lack of viable technology for the exploitation of deep fossil fuels • the early stage of development of nuclear fusion

3.3.1 Energy (continued)

	Environmental impacts	• CO_2, SO_x, NO_x produced by fossil fuel combustion • extraction damage caused by coal mining • oil spills • difficulties of safe disposal of radioactive waste
	Political and international trade problems	Disruption of supplies caused by political, military and trade problems
	Economic issues	Increasing prices of fossil fuels as supplies decline or reserves become more expensive to exploit
Renewable energy resources	Examples should be used to illustrate the factors affecting the ease of use of renewable energy resources and therefore their likely use in the future	
	Intermittence	Solar, wind, wave, tidal power vary in availability
		Tidal power is intermittent but very predictable
	Unreliability	Solar, wind, wave power cannot be predicted reliably
	Energy density	Solar, wind, wave power have low energy densities
		Hydroelectric power (HEP), biofuels have medium energy densities
	Ease of storage	Most cannot be stored – solar, wind, wave power
		Energy can be stored as potential energy of water in reservoirs and chemical energy in biofuels
	Environmental impact	Material use for equipment manufacture and siting of equipment, eg solar panel manufacture, siting windfarms
		Ecological effects of tidal barrages
	Geographical and locational constraints	The factors which limit the suitable sites for exploitation of solar, wind, HEP, tidal, geothermal power
	Suitability for current uses of energy	The difficulties in using solar, wind, HEP to drive road vehicles
	Level of technological development	The continuing improvements in technology to harness renewable energy • in-stream tidal turbines • photovoltaic cells • photothermal panels • wind turbines
	Economic issues	Initiatives to encourage the use of renewable energy

3.3.1 Energy (continued)

Secondary fuels	The use of secondary fuels to make the energy from primary fuels more useable	The energy conversions necessary to convert the available primary fuels into the required secondary fuels
	Electricity	Electricity generation from • chemical or nuclear energy in power stations • light energy using photovoltaic cells • chemical energy using fuel cells
	Hydrogen	Production by the electrolysis of water The use of hydrogen to store surplus energy from primary fuels, eg windpower The use of hydrogen as a high energy density vehicle fuel and in fuel cells The effect of the level of development of hydrogen technology on its use
Energy storage		The supply and demand for energy both vary, but often at different times. Many renewable resources can only be harnessed when natural processes make them available. Peak shaving involves the storage of a surplus to meet a later shortage. Pumped Storage Hydroelectric Power Stations Storage of chemical energy in rechargeable batteries and hydrogen
The environmental impacts of energy use	An outline of the environmental impacts associated with energy exploitation	Fuel extraction – coal mining, oil extraction Fuel processing – oil refining Manufacture of equipment Site development and operation – power stations, tidal barrages Waste disposal – coal spoil, radioactive waste Pipelines and cables
Future energy supplies	Energy supply problems	Depletion of existing resources Concern over environmental damage Meeting increased demand for energy caused by increasing affluence and population growth
	New technologies	New technologies may increase the amount of energy available for use by • increasing the amount of energy available from existing energy resources • allowing new resources to be exploited

3.3.1 Energy (continued)

	Energy conservation to reduce use and extended supplies	Domestic energy conservation • low energy appliances • insulation of roof, walls, floors, windows • consumer behaviour Transport energy conservation • bulk transport • vehicle design • modes of use Industrial energy conservation • heat recovery • insulation • recycling • high volume storage Reduced wastage by unnecessary use
	Energy use and supply mix	The choices made within a society about the amount of energy used and the sources to be exploited can affect other groups of people and societies.

3.3.2 Pollution

Topic Titles	**Main Issues**	**Details**
General properties of pollutants	Pollution is energy or matter released into the environment with the potential to cause adverse changes to an ecosystem	An understanding of the properties of pollutants and why they have caused problems should make it possible to predict the behaviour of new materials and therefore anticipate and prevent pollution problems.
	Important pollutant properties	• state of matter • density • point/diffuse sources • persistence/degradability • toxicity • chemical reactivity • solubility in water/lipids • synergism • mobility • bio-accumulation • bio-magnification • mutagenic action • carcinogenic action • teratogenic action These should be illustrated using suitable examples included in the unit.

3.3.2 Pollution (continued)

	The behaviour of pollutants in the environment	All pollutants have sources, pathways and sinks. The properties of a material determine its behaviour as to where it travels and for how long it acts. Environmental monitoring is used to detect and quantify pollutants. Critical Pathway Analysis can be used to predict the movement of pollutants and to plan monitoring programmes.
	Direct and indirect effects	Direct effects – the pollutant causes harm by contact with or ingestion by living organisms Indirect effects – the pollutant does not harm the organism directly but causes harmful changes to the environment Candidates should appreciate the distinctions between chronic and acute effects of pollution.
Atmospheric pollution	Global atmospheric system	Effective controls require national and international legislation and agreement to control trans-boundary pollutants.
	Acid rain The major causes of acid rain and their sources The direct effects of acid rain The indirect effects of acid rain on living organisms	The natural acidity of rain due to carbonic acid from dissolved carbon dioxide • SO_x • NO_x Other gases enhancing the acidic effects, eg ozone On non-living materials • corrosion of certain building stones/materials and metals On living organisms • phytotoxicity • aquatic organisms, exoskeletal development • respiratory difficulties/diseases • effect on lichens • effect on seed germination • deflocculation and acidification of soils • leaching of calcium and aluminium ions • availability of plant nutrients • mobilisation of heavy metals • increased susceptibility to pests and disease The use of lichens as biotic indicators to monitor sulfur dioxide concentrations Some areas are more sensitive to the effects of acid rain: effects of calcium content of rocks, precipitation patterns, spring snow melt.
	Tropospheric ozone	The origins of tropospheric ozone The harmful effects of tropospheric ozone • serious damage/death to humans (eye/nose inflammation, impaired lung functions) • plants (leaf lesions, impaired photosynthesis) Ozone can oxidise other substances to produce secondary pollutants.

3.3.2 Pollution (continued)

	Formation of smogs in basin topography with temperature inversions	The relationship between temperature and altitude under normal conditions and when there is a temperature inversion
	Smoke smogs	The sources of smoke • suspended particulate matter (SPM) from deforestation • incomplete combustion of fossil fuels and biofuels The effects of smoke smogs on buildings, humans and plants
	Photochemical smogs	Causes of photochemical smogs: NO_x, waste hydrocarbons and low-level ozone reacting to produce PANs (peroxy acetyl nitrates) in the presence of sunlight The effects of photochemical smogs: respiratory problems, damage to leaf cuticles
Air pollution controls	General methods	Legislation – examples include • the Clean Air Acts, the Montreal Protocol • Environmental Protection Act 1990 • various conventions on world climate such as Kyoto 1997 Reduced use of energy Fuel substitution
	Specific methods	SO_2, SO_3 : wet or dry flue-gas desulfurisation NO_x : low temperature combustion, catalytic converters, urea sprays Smoke: electrostatic precipitators, cyclone separators, more efficient combustion, scrubbers Methane: reduced use of landfill sites, gas collection during fossil fuel exploitation CFCs: use of alternative materials, products or techniques
Water pollution	Water bodies, including coastal waters and oceans, as the final sink for many pollutants. Relative mobility of pollutants in water	Factors influencing concentration • size of emissions • volume of water • residence time of water • degradation to include photodegradation • biodegradation • removal rate of the pollutant • dispersal
	Thermal pollution Ecological consequences Control	 • many species have a limited range of thermal tolerance • temperature dependence of gas solubility in water • increased rates of chemical reactions at higher temperature The use of cooling towers to lower effluent water temperature

3.3.2 Pollution (continued)

	Oil pollution	
	Causes	• poor disposal of used vehicle lubricants • accidental damage or leakage from ships, oil tankers, storage tanks, oil pipelines, oil refineries, oil drilling rigs • discharge of tank washing water from oil tankers
	Effects	• smothers aquatic life • some hydrocarbons are toxic • reduced thermal insulation of birds' feathers • inhibition of oxygen dissolving from the atmosphere • reduced bird feeding and breeding success
	Control	• recycling of waste oil • better maintenance and operation of ships and oil rigs • double hulled tankers • separate oil and water ballast tanks on tankers • oily waste water unloaded at refineries • oil traps to collect oil from drainage water • use of detergents/dispersants, absorbent materials, booms, skimmers, bioremediation by bacteria, seashore steam washing
	Pesticide pollution	
	Properties of pesticides which affect pollution	• specificity • persistence • bio-accumulation • bio-magnification • mobility
	Causes	Comparison of the relative harm caused by different pesticides
	Effects	• death/ill health of non-target species, including humans • food chain effects
	Control	• some are banned/restricted • preferred use of non-persistent, non bio-accumulative, specific pesticides • no spraying on windy days • only spray when pest risk is high • avoid use in more sensitive areas • use of non-chemical methods • careful disposal of containers

3.3.2 Pollution (continued)

Inorganic nutrient pollutants	**Nitrates** Sources Effects Control	 Fertiliser runoff • on humans, blue-baby syndrome (methaemoglobinanaemia), stomach cancer • on the aquatic environment (eutrophication) Slow release fertilisers, nitrate control areas, farming methods that reduce leaching
	Phosphates Sources Effects Control	 Fertiliser runoff, sewage effluent, silage fluids Cultural eutrophication, algal blooms which release toxins, shade macrophytes, break normal food chains and cause deoxygenation when the dead algae decompose Removal by tertiary treatment during sewage treatment
Organic nutrient pollutants	Sources Effects Control	Sewage, manure, silage fluids, food-processing waste, paper mills, leather tanneries • deoxygenation due to bacterial decomposition • pathogens may spread disease Effluent treatment – the purposes and principles of the processes in a sewage treatment works
	Acid mine drainage Sources	 Oxidation of sulfur from sulfide ores
	Water pollution monitoring	The assessment of water quality by physical, chemical and biological methods and their relative advantages and disadvantages The use of Biotic Index and Indicator Species
Heavy metal pollution	Effects of heavy metals	Most heavy metals have no physiological functions and cause damage by enzyme inhibition, especially of the nervous system and, in high doses, the liver and kidneys.
	General properties of heavy metals	Bioaccumulation Biomagnification Synergistic action, eg of cadmium and zinc Control by increasing pH
	Lead Sources Control	 Lead water pipes, petrol anti-knock agent, paint, lead dust in industry • lead no longer used in water pipes, petrol (in most countries) or in most paints • dust-free atmosphere in industry, respirators worn by workers, regular blood tests • low temperature paint removal

3.3.2 Pollution (continued)

	Mercury	The effect of chemical form on the severity of pollution: all mercury compounds are toxic, but organic compounds are more toxic and more fully absorbed into the body than inorganic or elemental mercury.
Noise pollution	Effects of noise pollution	Effects on organisms: including deafness, stress, nervous disorders or behavioural changes, disturbance and breeding failure Effects on objects: noise vibrations can cause 'acoustic fatigue' where stress cracks appear resulting in structural damage
	Sources of noise and control methods	Industrial machinery noise controlled by: sound insulation, hearing protection, limited periods of exposure, changed industrial processes Transport noise • road vehicle noise controlled by: vehicle design, use, routing, absorption • aircraft noise controlled by: aircraft design and operation, airport location, design, operation, insulation • railway noise controlled by: vibration absorbing ballast beneath the rails Domestic sources of noise (kitchen appliances, garden equipment, music) controlled by: improved sound insulation, considerate use
	Measuring noise pollution	dB scale, dBA scale, NNI scale
Ionising radiation	Effects of ionising radiation on living organisms	Production and effects of free radicals on somatic and gonadic cells Exposure levels related to source, distance and period of exposure and use of barriers
	Sources of radiation exposure	Natural and caused by human activities
	Uses of radioactive materials	The range of uses of radioactive materials which involve risks but provide benefits The principles of risk benefit analysis
	Control methods	Closed sources, absorbers, distance from source, period of exposure, worker monitoring
	Monitoring programmes	The materials which are likely to be sampled to test for contamination by radioactive materials Critical Pathway Analysis: the prediction of the movement of pollutants in the environment Critical Group Studies: the identification of those members of the public that, due to their lifestyles, are most at risk

3.3.2 Pollution (continued)

Solid wastes	Sources of solid waste	The sources of the different types of solid waste • mining and construction • municipal (domestic and commercial) • industrial • agricultural
	Properties of solid waste	• composition relating to bulk and mobility • degradability • flammability • radioactivity • toxicity
	Control of solid waste	The link between waste and affluence. Built-in obsolescence, convenience, disposable products, over-packaging
	Methods of solid waste treatment	The economic and environmental advantages and disadvantages of disposal by • landfill and land raising on derelict land/exhausted quarries • incineration and pyrolysis of household and industrial wastes • encapsulation/vitrification of high-level radioactive waste
	Salvaging and recycling	The reduction of resource exhaustion and waste production including • efficient use of resources within a manufacturing enterprise to include extraction efficiency • production loops eg trimmings from plastic mouldings/paper cutting Resource substitution to use a more abundant material instead of a less abundant one, eg plastics replacing metal Re-use and recycling of resource materials to include composting The scientific/technological, social and economic problems of recycling compared with use of virgin materials with specific reference to aluminium: waste losses, eg litter, mixed alloys, transport, labour costs, separation, identification, energy costs, need for public co-operation

3.3.3 Practical Skills

Practical skills	Candidates should be able to use the practical skills gained in Units 1 and 2 as they apply to this unit	
	Candidates should have first-hand experience of measuring the following:	
	The effects of climatic variability on the use of renewable energy resources	Variations in light intensity, wind velocity and precipitation
	Factors affecting the rate of heat loss	Insulation and volume
	The effects of atmospheric pollution on lichen populations	
	The effects of pH on seed germination	
	The effects of water turbidity on light penetration	
	The effects of inorganic nutrients on aquatic plant growth	
	Factors affecting noise levels	Distance from source and acoustic insulation

3.4 Unit 4 ENVS4 Biological Resources and Sustainability

The growth of the human population and increased materialism are considered in relation to the demands placed upon the planet's resources and life-support systems.

Food production and forestry systems are analysed, with particular emphasis on the limiting factors affecting productivity, the environmental problems caused by these systems and the ways in which problems can be addressed.

The study of the sustainability of human lifestyles allows synoptic consideration of the other modules of the specification.

3.4.1 Human Populations

Topic Titles	Main Issues	Details
The impact of individuals on the environment	Population: resource balance – the concept of sustainability	Comparison of the effects of population size and per capita consumption on resource use The environmental impact of individual lifestyles varies greatly and is influenced by: affluence, personal choices and the products and services available Education for responsible global citizenship – Agenda 21

3.4.2 Food Production Systems

Topic Titles	Main Issues	Details
Nutrition	Autotrophic nutrition	The basis of all agriculture All food production relies directly or indirectly on photosynthesis, eg crops, dairy products, livestock, farmed fish which are fed on herbivorous fish
	Heterotrophic nutrition	The nature of heterotrophic nutrition as it relates to agricultural systems Candidates should have a basic understanding of the use of herbivores, omnivores and carnivores in terms of • the efficiency of food utilisation • the ability to live in different environments • food chain efficiency
Agroecosystems	Principles of agroecosystems	Factors which affect the selection of food species: environmental, social, religious, ethical, technological factors Manipulation of food species to increase its saleability, yield and suitability for cultivation Control of the environment to maximise yield and marketability

3.4.2 Food Production Systems (continued)

Manipulation of the food species	Population control Monocultures	Optimum livestock/crop densities Advantages • ease of pest control, fertiliser use and machinery use • low labour inputs • economies of scale Disadvantages • ease of colonisation by pests • rapid spread of pests and disease • reliance on mechanisation
	Genetic manipulation Selective breeding – outbreeding and crossbreeding	An outline of the purposes of genetic manipulation, in terms of their advantages, disadvantages and limitations • to remove undesirable characteristics • to enhance desirable characteristics • to combine different desirable characteristics Artificial insemination and embryo transfer Selective breeding has produced varieties that have • improved food conversion ratios – growth rate/Gross Growth Efficiency • more desirable qualities – taste, nutritional content • pest and disease resistance • uniformity of appearance, timing of growth stages, increased dependence on husbandry by humans
	Vegetative propagation and micropropagation	To enable the rapid production of genetically identical individuals
	Genetic engineering and transgenics GM crops and livestock	Advantages • increased growth rates • improved nutritional value • increased pest resistance • ease of management • tolerance of unfavourable conditions Disadvantages • genetic contamination • greater use of pesticides • control of agriculture by corporations • development of superweeds • threats to biodiversity
	Agrochemicals used to manipulate the food species Plant hormones	Plant growth hormones are used to control aspects of plant growth

3.4.2 Food Production Systems (continued)

	Animal hormones	Steroid hormones increase the Gross Growth Efficiency of livestock and produce more lean, less fatty meat but meat which still contains the hormones may affect those that eat it. BST is not a steroid hormone. It increases milk production in dairy cattle but is not active in humans.
Artificial control of the environmental factors that limit production		An understanding of limiting factors helps to increase food production Temperature control in glasshouses and livestock rearing units Light control to increase the rate of photosynthesis and influence animal breeding Carbon dioxide control in glasshouses to increase the rate of photosynthesis Water control by drainage, irrigation and humidity control to maintain turgidity, allow nutrient uptake and reduce waterlogging Windbreaks and shelterbelts reduce frost damage, transpiration and physical damage and maintain soil temperature Nutrient availability: macronutrients and micronutrients. Advantages and disadvantages of natural and artificial fertilisers, green manures, legumes and liming to maintain supplies pH control to enhance nutrient uptake by roots involving ion exchange Manipulation of energy flow by short, simple food chains which convert a greater proportion of the original photosynthetic energy into food. Reduction of livestock energy use by restricting movement and keeping them warm to reduce heat loss
	Control of competition	Pest control by • cultural methods: weeding, mulching, crop rotation, barrier crops, culling, biological control, predator habitats, integrated control, polyculture/companion crops • chemical pesticides: contact and systemic action • the use of antibiotics to control bacteria and Gross Growth Efficiency of the livestock. The risk of excessive or unnecessary use
Environmental and social impacts of agriculture	Habitat impacts Pollution Changes to the hydrological cycle	• forest clearance • drainage of wetlands • ploughing of grasslands • reduction of biodiversity • GM contamination caused by pesticides, nutrients, methane, increased river turbidity • increased irrigation causing reduced river flow and aquifer depletion • increased surface runoff caused by soil compaction • changes in evapotranspiration compared with previous vegetation

3.4.2 Food Production Systems (continued)

	Accelerated soil erosion	Soil erosion as a natural process by rain splash, wind blow and surface runoff Natural features of soil which reduce erosion • vegetation • organic matter • high infiltration rate Accelerated soil erosion where erosion exceeds formation Universal soil loss equation (USLE) The long timescale of soil formation compared with the rapidity of soil erosion Human activities which increase the risk of soil erosion • deforestation • overgrazing • reducing soil organic matter content • reduced soil biota • ploughing vulnerable soils • cultivating steep slopes • soil compaction The effects of soil erosion • reduced productivity • sedimentation in rivers and reservoirs • flooding downstream • coastal sedimentation • increased atmospheric particulates • desertification • landslides
		Soil conservation techniques • cultivation of long-term crops • contour ploughing and tied ridges • terracing • windbreaks • multicropping • strip cropping • mulching • increasing organic matter
	Social impacts	The uneven distribution of food leads to malnutrition in communities which cannot afford to import food. The misuse of the land and pollution results in the loss of natural productivity, famine and refugee movements. Production of cash crops can replace subsistence farming causing subsistence farmers to become landless.

3.4.2 Food Production Systems (continued)

Agricultural energetics		The relationship between energy inputs and harvestable product Productivity = yield/unit area Efficiency = yield/unit input Intensive/extensive systems in terms of inputs of labour and capital, yield per unit area, amount and types of input and the level of input per unit area The high productivity and low efficiency of intensive agriculture Agroecosystems require energy subsidies: fossil fuels, human labour, machinery and locomotive energy, mechanical power for the application of fertilisers, energy to manufacture agrochemicals A comparison of the energy ratios of different agricultural production systems and different crop plants and animals
Social/economic/ political factors which influence agricultural production		The role of trade organisations, subsidies, pricing and infrastructure The increased consumer demand for Fairtrade foods The effect of world trade on income and food production in Less Economically Developed Countries (LEDC) Responses to over-production and resource exhaustion: • reducing cultivated area • quotas • diversification (non-food crops, conservation cropping, recreation, small-scale industry) • habitat restoration Strategies to increase sustainability including agri-environmental schemes, subsidies and planning and development control

3.4.3 Aquatic Food Production Systems

Topic Titles	Main Issues	Details
Fishing	Factors controlling marine productivity	The difference in the productivity of continental shelves and open oceans Nutrient cycles (especially phosphorus) related to upwellings, ocean currents and coastal inputs
	Fish populations	The relationship between biomass, recruitment, growth, mortality and capture
	Maximum Sustainable Yield (MSY)	The concept of Maximum Sustainable Yield and the difficulties in calculating it. MSY is the maximum harvest that will not reduce the ability of the population to replace losses.
	Fishing techniques	Candidates should consider trawling, longlining, purse seining and drift netting and the use of factory ships in terms of the selectivity of the catch, environmental impacts and energy inputs.

3.4.3 Aquatic Food Production Systems (continued)

	Environmental impact of fishing	Effects of fishing on fish stocks: overfishing, exceeding the Maximum Sustainable Yield, changed age structure The impact of harvesting target species on marine food chains and on non-food species which lose their predators/food source By-catch, ghost fishing, seabed damage
	Management of marine production systems	• catch quotas • net design: mesh design, escape panels • fishing effort limits • exclusion zones • closed-seasons • minimum catchable size • captive breeding boost wild population
Aquaculture – fish farming	The principles of aquaculture	• stock selection • breeding • control of disease • control of competition • nutrition • manipulation of the abiotic environment (temperature, dissolved oxygen, light levels)
		Environmental problems caused by aquaculture: • organic wastes – deoxygenation, nutrient enrichment, increased turbidity • escapes – effect on wild gene pool, non-native species • lice – spread of disease • pollution caused by pesticides • loss of habitat/biodiversity • impact on tourism • coastal erosion caused by mangrove loss • effect of harvesting wild fish populations to provide food
	The energetics of aquatic food production	A comparison of the energy efficiencies of fishing and aquaculture

3.4.4 Forestry

Topic Titles	Main Issues	Details
Forest resources	The forest crop as a source of renewable resources and services	Resources: timber, fuel, food, fibres, medicines Life-support services • atmospheric regulation • a habitat and wildlife refuge • regulation of the water cycle • climate regulation on regional and local scales • soil conservation • shelter and a microclimate • recreation and amenity uses
	Forests production	The selection of products to be harvested from a wild community or grown in a plantation The simplified structure of plantations compared with natural woodlands: reduced species diversity, stratification and age structure The differences in consumption of forest products by More and Less Economically Developed Countries The sources of UK timber and timber products
Deforestation	The causes of deforestation	• harvesting above the Maximum Sustainable Yield for fuel and timber • insufficient replanting • clearance for other land uses, including agriculture, mineral extraction, road construction, reservoirs The application of the concept of Maximum Sustainable Yield and sustainable management The role of the Forest Stewardship Council
	The environmental, social and economic consequences of deforestation	• loss of species diversity • loss of the resources and place to live for indigenous people • loss of tradeable resources and materials • loss of a carbon reservoir to reduce global climate change • reduced evapotranspiration • increased ground albedo • loss of visual amenity • loss of recreational/ecotourism opportunity • a comparison of selective logging and clear felling The contradiction of deforested MEDCs criticising LEDCs for wanting to exploit their forests

3.4.5 Sustainability

Topic Titles	Main Issues	Details
Unsustainable lifestyles		Lifestyles often change to provide a higher level of material benefit and comfort at the expense of the environment, less affluent communities, future resources supplies and the ability of Earth to support life.
Attempts to achieve sustainable development	Global strategies for sustainable development (Brundtland definition)	with particular reference to • air, water and land quality • transport systems • waste management/minimisation • awareness raising in the community • Agenda 21 (Rio de Janeiro 1992)
The main sections of the specification should be considered synoptically to identify the links between them	The sustainability of current resource exploitation and strategies to increase the sustainability of exploitation of: Data should be analysed to enable critical comments to be made on two key questions: Is human resource use sustainable and, if not, how can it be made so? What can individuals, groups and the authorities do at the local, national and international level to make resource use more sustainable?	• biotic resources: plant and animal species and their habitats • water resources • metal, mineral and rock resources • energy resources • food production • land resources
Human populations		The effect of levels of affluence on resource exploitation and environmental degradation The effect of the uneven distribution of resources on development

3.4.6 Practical Skills

Practical skills	Candidates should be able to use the practical skills gained in Units 1 and 2 as they apply to this unit	
	Candidates should have first-hand experience of investigating the following:	
	The effect of slope and vegetation on rain splash soil erosion	
	The effect of trees on microclimates	
	The effect of land use on biodiversity and community species composition	

3.5 How Science Works

How Science Works is an underpinning set of concepts and the means whereby students come to understand how scientists investigate scientific phenomena in their attempts to explain the world about us. Moreover, *How Science Works* recognises the contribution scientists have made to their own disciplines and to the wider world.

Further, it recognises that scientists may be influenced by their own beliefs and that these can affect the way in which they approach their work. Also, it acknowledges that scientists can and must contribute to debates about the uses to which their work is put and how their work influences decision-making in society.

In general terms, it can be used to promote students' skills in solving scientific problems by developing an understanding of:

- the concepts, principles and theories that form the subject content
- the procedures associated with the valid testing of ideas and, in particular, the collection, interpretation and validation of evidence
- the role of the scientific community in validating evidence and also in resolving conflicting evidence.

As students become proficient in these aspects of *How Science Works*, they can also engage with the place and contribution of science in the wider world. In particular, students will begin to recognise:

- the contribution that scientists can make to decision-making and the formulation of policy
- the need for regulation of scientific enquiry and how this can be achieved
- how scientists can contribute legitimately in debates about those claims which are made in the name of science.

An understanding of *How Science Works* is a requirement for this specification and is set out in the following points which are taken directly from the *GCE AS and A Level subject criteria for science subjects*. Each point is expanded in the context of Environmental Studies. The specification references given illustrate where the example is relevant and could be incorporated.

Use theories, models and ideas to develop and modify scientific explanations

Candidates will be expected to:

- propose hypotheses and design appropriate investigations based on their understanding of environmental systems
- explain results of investigations in terms of scientific concepts and link these with environmental systems
- compare differing views in terms of their ability to explain environmental events
- apply environmental knowledge to unfamiliar situations.

Example of Learning Activity: *Students might explore the factors that have influenced the depletion of ozone in the ozonosphere and explanations of the effects of the chemicals involved (3.1.1, 3.2.1).*

Assessment Example: *Candidates might be required to apply their knowledge of the behaviour of pesticides to explain their impact on the environment (3.3.2).*

Use knowledge and understanding to pose scientific questions, define scientific problems, present scientific arguments and scientific ideas

Candidates will be expected to use knowledge of environmental theory and research to:

- propose hypotheses related to environmental systems and events
- identify appropriate issues for environmental investigations
- explain environmental processes and concepts
- present informed environmental arguments.

Example of Learning Activity: *Students might use their knowledge and understanding of the effects of atmospheric gases, such as carbon dioxide and methane, to explore the proposed explanations of global climate change (3.1.2, 3.2.1, 3.3.2).*

Assessment Example: *Candidates might review findings of research on the effect of changes in atmospheric carbon dioxide and methane on global temperatures, the melting of land ice, expansion of water and rising sea levels (3.1.2, 3.2.1, 3.3.2).*

Use appropriate methodology, including ICT, to answer scientific questions and solve scientific problems

Candidates will be expected to:

- choose methods appropriate for the investigation of environmental systems
- plan and have a knowledge of the practical procedures involved in scientific investigations that have an environmental studies application
- use ICT to prepare materials for an investigation
- use ICT to analyse and present data from environmental investigations.

Example of Learning Activity: *Students might investigate biotic and abiotic factors which affect the distribution of species within particular environments (3.1.3, 3.1.4).*

Assessment Example: *Candidates might be required to plan an investigation to explore ecological succession within a named environment (3.1.3, 3.1.4).*

Carry out experimental and investigative activities, including appropriate risk management in a range of contexts

Candidates will be expected to:

- take part in individual, group and class investigations using experimental and other methods to investigate environmental systems
- understand the need to standardise conditions and methods, eliminate bias and evaluate different methodologies
- consider possible health and safety risks to all group members and adjust activities accordingly.

Example of Learning Activity: *Students might conduct an investigation into population size of a named species within a particular environment, having first prepared a risk assessment (3.1.3, 3.1.4).*

Assessment Example: *Candidates might discuss the health and safety risks associated with carrying out population or species diversity estimations in a river, on the sea shore or in a wood (3.1.3, 3.1.4).*

Analyse and interpret data to provide evidence, recognising correlations and causal relationships

Candidates will be expected to:

- analyse and interpret raw and summary data from environmental investigations in class
- explain and interpret summary data from environmental investigations in examinations
- interpret and draw conclusions from the findings of their own and others' investigations
- understand the difference between correlation and cause and effect relationships.

Example of Learning Activity: *Students might collect data for a range of biotic and abiotic factors and the distribution of named species within a given environment, analysing the data to explore any correlations (3.1.3, 3.1.4).*

Assessment Example*: Candidates might be given tables or graphs of summary data from an investigation into the components of different soils and be required to relate these to information about porosity and permeability (3.2.2, 3.2.3).*

Evaluate methodology, evidence and data, and resolve conflicting evidence

Candidates will be expected to:

- evaluate environmental investigations in terms of issues such as reliability, validity and ethics
- evaluate evidence on the basis of the method used to gather the evidence
- explain anomalous figures in a set of data
- explain inconsistencies in data
- use a range of statistical tests to confirm the significance of any differences noted
- present conclusions, explaining sources of error and levels of accuracy.

Example of Learning Activity: *Students might be given sets of data on animal distribution in river water upstream and downstream of a sewage works and asked to identify and explain any anomalous observations, or compare the relationship between energy use and affluence (3.3.2).*

Assessment Example*: Candidates might discuss the use of a range of methods to estimate the size of different animal populations (3.1.3, 3.1.4).*

Appreciate the tentative nature of scientific knowledge

Candidates will be expected to:

- understand the features and principles of the scientific approach in environmental studies including an analysis of alternative views, the role of theory, the raising and testing hypotheses, the importance of replication and the role of generalisation.

Example of Learning Activity: *Students might carry out their own investigation into the effects of increasing levels of nitrate and phosphate on algal growth using replicate samples, and make generalisations based on the results obtained (3.2.3, 3.3.2).*

Assessment Example*: Candidates might discuss the causes and effects of chronic pollution events or explore biodiversity and inter-relationships between different species (3.3.2).*

Communicate information and ideas in appropriate ways using appropriate terminology

Candidates will be expected to:

- use the appropriate environmental terminology to express environmental ideas, describe environmental concepts and events, interpret and explain environmental findings and describe and discuss environmental theories.

Example of Learning Activity: *Students might design and carry out a practical investigation in groups, and present and analyse the results, using appropriate environmental terminology (in all 4 units).*

Assessment Example*: Candidates might read an article on sustainability and be required to describe and explain the environmental information it contains, with suitable reference to environmental theories (3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.5).*

Consider applications and implications of science and appreciate their associated benefits and risks

Candidates will be expected to:

- understand and appreciate a range of applications of environmental studies
- understand and appreciate the implications of environmental findings
- evaluate the contribution of environmental research in terms of benefits and risks.

Example of Learning Activity: *Students might evaluate information about the treatment of waste, such as landfill, incineration and recycling, considering the benefits and risks involved (3.3.2).*

Assessment Example*: Candidates might discuss the arguments for and against the development of a new generation of nuclear reactors or the siting of wind turbines in areas close to or within National Parks (3.1.3).*

Consider ethical issues in the treatment of humans, other organisms and the environment

Candidates will be expected to:

- understand, appreciate and take account of ethical issues when planning and carrying out investigations, whether in the laboratory or the environment
- discuss ethical considerations relating to global environmental issues
- discuss the ethical aspects of other environmental investigations
- discuss the ethical aspects of voluntary or statutory environmental agreements taken locally and globally.

Example of Learning Activity: *Students might explore, through role-play, the benefits and risks associated with the clearance of tropical rain forests as they affect indigenous populations (3.1.2, 3.2.3, 3.4.2, 3.4.4).*

Assessment Example*: Candidates might discuss ethical issues associated with the reintroduction of predator species, such as the Red Kite or White-tailed Eagle, previously hunted to extinction in parts of Britain (3.1.2).*

Appreciate the role of the scientific community in validating new knowledge and ensuring integrity

Candidates will be expected to:

- understand the way in which the scientific community assesses new contributions to a body of research
- be aware that new research may question previous environmental theories and assumptions
- understand the process of peer review as a prerequisite to publication
- understand the role of professional journals.

Example of Learning Activity*: Students might compare published articles on the effects of increases in greenhouse gases on global climate change with newspaper articles which outline the possible benefits for inhabitants in Britain of a potentially warmer climate (3.2.1, 3.4.4).*

Assessment Example*: Candidates might discuss the opposing scientific views associated with the desirability of extending our reliance on nuclear fuels for electricity supplies (3.1.3).*

Appreciate the ways in which society uses science to inform decision-making

Candidates will be expected to:

- understand how environmental research contributes to decision-making in areas such as action to reduce global climate change, nuclear energy, environmental protection: including pollution controls, conservation, fish quotas, and planning.

Example of Learning Activity: *Students might explore the evidence used to calculate 'Maximum Sustainable Yields' which has informed the introduction of fish quotas in an attempt to protect populations of, for instance, North Sea cod (3.1.3, 3.4.3).*

Assessment Example*: Candidates might discuss how scientific evidence on the environmental effects of a proposed development might be presented to a public inquiry (3.1.3).*

3.6 Mathematical Requirements

In order to be able to develop the knowledge, understanding and skills in the specification, candidates need to have been taught and to have acquired competence in the areas of mathematics set out below

- recognise and use expressions in decimal and standard number form
- use ratios, fractions and percentages
- make estimates of the results of calculations (without using a calculator)
- use calculators to find and use x^n, $1/x$, $\sqrt{x}$
- display and interpret frequency tables and diagrams, bar charts and histograms
- plot and interpret graphs involving two variables which show linear or non-linear relations; use logarithmic scales where appropriate
- calculate rates of change from graphs which show linear relations
- plot and interpret scatter diagrams to identify a correlation between two variables; appreciate that a correlation does not establish a causal relationship (candidates will **not** be expected to calculate correlation coefficients)
- recognise a normal distribution; understand the arithmetic mean, the median and the mode and the standard deviation; calculate an arithmetic mean (but **not** standard deviation) from given data
- have a general understanding of levels of significance in drawing conclusions from experimental data and of the need for statistical tests to establish these levels

A Level candidates should also be familiar with the use of the following statistical tests, understand when they might be validly applied and be able to interpret results obtained. Candidates will **not** be expected to recall the formulae in written papers

- Mann-Whitney U Test
- Spearman Rank Correlation
- Chi squared test
- t-Test

4 Scheme of Assessment

4.1 Aims

AS and A Level courses based on this specification should encourage candidates to:

a) develop their interest in and enthusiasm for the subject, including developing an interest in further study and careers in the subject

b) appreciate how society makes decisions about scientific issues and how the sciences contribute to the success of the economy and society

c) develop and demonstrate a deeper appreciation of the skills, knowledge and understanding of *How science works*

d) develop essential knowledge and understanding of different areas of the subject and how they relate to each other.

4.2 Assessment Objectives (AOs)

The Assessment Objectives are common to AS and A Level. The assessment units will assess the following Assessment Objectives in the context of the content and skills set out in Section 3 (Subject Content).

In the context of these assessment objectives, the following definitions apply.

- Knowledge includes facts, specialist vocabulary, principles, concepts, theories, models.
- Issues include ethical, social, economic, environmental, cultural, political and technological.
- Processes include collecting evidence, explaining, theorising, modelling, validating, interpreting, planning to test an idea, peer reviewing.

AO1: Knowledge and understanding of science and *How science works*

Candidates should be able to:

a) recognise, recall and show understanding of scientific knowledge

b) select, organise and communicate relevant information in a variety of forms.

AO2: Application of knowledge and understanding of science and *How science works*

Candidates should be able to:

a) analyse and evaluate scientific knowledge and processes

b) apply scientific knowledge and processes to unfamiliar situations including those related to issues

c) assess the validity, reliability and credibility of scientific information.

AO3: *How science works*

Candidates should be able to:

a) describe ethical, safe and skilful practical techniques and processes, selecting appropriate qualitative and quantitative methods

b) know how to make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy, through using primary and secondary sources

c) explain how a range of experimental methods may be brought together and used to explore how various environmental systems interrelate

d) analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigative activities in a variety of ways.

It is expected, however, that Environmental Studies candidates should still carry out investigative activities, appropriate to the study of the range of environmental systems and how they influence and affect each other.

Quality of Written Communication (QWC)

In GCE specifications which require candidates to produce written material in English, candidates must:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

In this specification, QWC will be assessed in all units by means of the longer response questions. Questions where QWC applies will be clearly identified in the question paper. A maximum of 2 marks will be available for QWC and the mark schemes will show clearly how these marks are awarded.

Mark	Descriptor
2	All material is logically presented in clear, scientific English and continuous prose. Technical terminology has been used effectively and accurately throughout. At least half a page of material is presented.
1	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate. Some minor errors. At least half a page of material is presented.
0	The account is generally poorly constructed and often fails to use an appropriate scientific style to express ideas.

In Unit 1 an appropriate question will be identified. In Unit 2 QWC will apply to the extended prose question and in Units 3 and 4 QWC will be assessed in the essay question.

Weighting of Assessment Objectives for AS

The table below shows the approximate weighting of each of the Assessment Objectives in the AS units.

Assessment Objectives	Unit Weightings (%)		Overall Weighting of AOs (%)
	Unit 1	Unit 2	
AO1	18	22	40
AO2	16	24	40
AO3	6	14	20
Overall weighting of units (%)	40	60	100

Weighting of Assessment Objectives for A Level

The table below shows the approximate weighting of each of the Assessment Objectives in the AS and A2 units.

Assessment Objectives	Unit Weightings (%)				Overall Weighting of AOs (%)
	Unit 1	Unit 2	Unit 3	Unit 4	
AO1	9	11	8.4	6.6	35
AO2	8	12	12.5	12.5	45
AO3	3	7	4.1	5.9	20
Overall weighting of units (%)	20	30	25	25	100

4.3 National Criteria

This specification complies with the following

- the Code of Practice for GCE
- the GCE AS and A Level Qualification Criteria
- the Arrangements for the Statutory Regulation of External Qualifications in England, Wales and Northern Ireland: Common Criteria

4.4 Prior Learning

We recommend that candidates should have acquired the skills and knowledge associated with a GCSE Science/Additional Science course or equivalent.

However, any requirements set for entry to a course following this specification are at the discretion of centres.

4.5 Synoptic Assessment and Stretch and Challenge

Synoptic assessment in Environmental Studies is assessed in the A2 units by

- questions which require applying knowledge and understanding of principles to a particular situation or context
- questions requiring knowledge and understanding of principles and concepts in order to plan experimental and investigative work and to analyse and evaluate data
- questions, such as essay questions, which require the candidate to bring together scientific knowledge and understanding from different areas of Environmental Studies and apply them

The requirement that Stretch and Challenge is included at A2 is met by constructing questions which

- use a variety of stems in questions, eg evaluate, discuss, compare
- contain a number of related parts evaluating in depth questioning where appropriate
- require extended writing
- are of different types, eg open-ended questions, essays
- include synoptic assessment

4.6 Access to Assessment for Disabled Students

AS/A Levels often require assessment of a broader range of competences. This is because they are general qualifications and, as such, prepare candidates for a wide range of occupations and higher level courses.

The revised AS/A Level qualification and subject criteria were reviewed to identify whether any of the competences required by the subject presented a potential barrier to any disabled candidates. If this was the case, the situation was reviewed again to ensure that such competences were included only where essential to the subject. The findings of this process were discussed with disability groups and with disabled people.

Reasonable adjustments are made for disabled candidates in order to enable them to access the assessments. For this reason, very few candidates will have a complete barrier to any part of the assessment.

Candidates who are still unable to access a significant part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award. They would be given a grade on the parts of the assessment they have taken and there would be an indication on their certificate that not all the competences had been addressed. This will be kept under review and may be amended in the future.

5 Administration

5.1 Availability of Assessment Units and Certification

Examinations and certification for this specification are available as follows:

	Availability of units		Availability of certification	
	AS	A2	AS	A Level
January 2009	✔ (Unit 1 only)			
June 2009	✔		✔	
January 2010	✔		✔	
June 2010	✔	✔	✔	✔
January 2011 onwards	✔		✔	✔
June 2011 onwards	✔	✔	✔	✔

5.2 Entries

Please refer to the current version of *Entry Procedures and Codes* for up to date entry procedures. You should use the following entry codes for the units and for certification.

Unit 1 - ENVS1
Unit 2 - ENVS2
Unit 3 - ENVS3
Unit 4 - ENVS4

AS certification - 1441
A Level certification - 2441

5.3 Private Candidates

This specification is available to private candidates. Private candidates should write to AQA for a copy of *Supplementary Guidance for Private Candidates*.

5.4 Access Arrangements and Special Consideration

We have taken note of equality and discrimination legislation and the interests of minority groups in developing and administering this specification.

We follow the guidelines in the Joint Council for Qualifications (JCQ) document: *Access Arrangements, Reasonable Adjustments and Special Consideration: General and Vocational Qualifications.* This is published on the JCQ website (**http://www.jcq.org.uk**) or you can follow the link from our website (**http://www.aqa.org.uk**).

Access Arrangements

We can make arrangements so that candidates with disabilities can access the assessment. These arrangements must be made **before** the examination. For example, we can produce a Braille paper for a candidate with a visual impairment.

Special Consideration

We can give special consideration to candidates who have had a temporary illness, injury or indisposition at the time of the examination. Where we do this, it is given **after** the examination.

Applications for access arrangements and special consideration should be submitted to AQA by the Examinations Officer at the centre.

5.5 Language of Examinations

We will provide units in English only.

5.6 Qualification Titles

Qualifications based on this specification are:

- AQA Advanced Subsidiary GCE in Environmental Studies, and
- AQA Advanced Level GCE in Environmental Studies.

5.7 Awarding Grades and Reporting Results

The AS qualification will be graded on a five-point scale: A, B, C, D and E. The full A Level qualification will be graded on a six-point scale: A*, A, B, C, D and E. To be awarded an A*, candidates will need to achieve a grade A on the full A Level qualification and an A* on the aggregate of the A2 units.

For AS and A Level, candidates who fail to reach the minimum standard for grade E will be recorded as U (unclassified) and will not receive a qualification certificate. Individual assessment unit results will be certificated.

5.8 Re-sits and Shelf-life of Unit Results

Unit results remain available to count towards certification, whether or not they have already been used, as long as the specification is still valid.

Candidates may re-sit a unit any number of times within the shelf-life of the specification. The best result for each unit will count towards the final qualification. Candidates who wish to repeat a qualification may do so by re-taking one or more units. The appropriate subject award entry, as well as the unit entry/entries, must be submitted in order to be awarded a new subject grade.

Candidates will be graded on the basis of the work submitted for assessment.

Appendices

A Performance Descriptions

These performance descriptions show the level of attainment characteristic of the grade boundaries at A Level. They give a general indication of the required learning outcomes at the A/B and E/U boundaries at AS and A2. The descriptions should be interpreted in relation to the content outlined in the specification; they are not designed to define that content.

The grade awarded will depend in practice upon the extent to which the candidate has met the Assessment Objectives (see Section 4) overall. Shortcomings in some aspects of the examination may be balanced by better performances in others.

AS Performance Descriptions for Environmental Studies

	AO1	AO2	AO3
	Knowledge and understanding of science and of *How science works* Candidates should be able to: • recognise, recall and show understanding of scientific knowledge • select, organise and communicate relevant information in a variety of forms.	**Application of knowledge and understanding of science and of *How science works*** Candidates should be able to: • analyse and evaluate scientific knowledge and processes • apply scientific knowledge and processes to unfamiliar situations including those related to issues • assess the validity, reliability and credibility of scientific information.	***How science works*** Candidates should be able to: • describe ethical, safe and skilful practical techniques and processes, selecting appropriate qualitative and quantitative methods • know how to make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy, through using primary and secondary sources • explain how a range of experimental methods may be brought together and used to explore how various environmental systems interrelate • analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigative activities in a variety of ways.
A/B boundary performance descriptions	Candidates characteristically: a) recall most facts and principles from the AS specification b) show understanding of most principles and concepts from the AS specification c) select relevant information from the AS specification d) organise and present information clearly, using scientific terminology in appropriate contexts.	Candidates characteristically: a) apply principles and concepts in familiar and new contexts involving only a few steps in the argument b) describe significant trends and patterns shown by data presented in a variety of forms and interpret phenomena with few errors and present arguments and evaluations clearly c) comment critically on statements, conclusions or data d) successfully carry out appropriate calculations specified for AS e) successfully translate data presented as prose, diagrams, drawings, tables or graphs from one form to another.	Candidates characteristically: a) devise and plan experimental and investigative activities, selecting appropriate techniques b) describe safe and skilful practical techniques c) know how to make observations and measurements with appropriate precision and record these methodically d) interpret, explain, evaluate and communicate the results of experimental and investigative activities, in appropriate contexts.
E/U boundary performance descriptions	Candidates characteristically: a) recall some facts and principles from the AS specification b) show understanding of some principles from the AS specification c) select some relevant information from the AS specification d) present information using basic scientific terminology from the AS specification.	Candidates characteristically: a) apply a given principle to material presented in familiar or closely related contexts involving only a few steps in the argument b) describe some trends or patterns shown by data presented in a variety of forms c) when directed, identify inconsistencies in conclusions or data d) carry out straightforward calculations from the AS specification with partial success e) translate data presented as prose, diagrams, drawings, tables or graphs from one form to another with partial success.	Candidates characteristically: a) devise and plan some aspects of experimental and investigative activities b) describe safe practical techniques c) know how to make observations and measurements, and record them d) interpret, explain and communicate some aspects of the results of experimental and investigative activities, in appropriate contexts.

A2 Performance Descriptions for Environmental Studies

	AO1	AO2	AO3
	Knowledge and understanding of science and of *How science works*	**Application of knowledge and understanding of science and of *How science works***	***How science works***
	Candidates should be able to:	Candidates should be able to:	Candidates should be able to:
	• recognise, recall and show understanding of scientific knowledge • select, organise and communicate relevant information in a variety of forms.	• analyse and evaluate scientific knowledge and processes • apply scientific knowledge and processes to unfamiliar situations including those related to issues • assess the validity, reliability and credibility of scientific information.	• describe ethical, safe and skilful practical techniques and processes, selecting appropriate qualitative and quantitative methods • know how to make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy, through using primary and secondary sources • explain how a range of experimental methods may be brought together and used to explore how various environmental systems interrelate • analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigative activities in a variety of ways.
A/B boundary performance descriptions	Candidates characteristically: a) recall most facts and principles from the A2 specification b) show understanding of most principles and concepts from the A2 specification c) select relevant information from the A2 specification d) organise and present information clearly, using scientific terminology in appropriate contexts.	Candidates characteristically: a) apply principles and concepts in familiar and new contexts involving several steps in the argument b) describe significant trends and patterns shown by complex data presented in a variety of forms, and interpret phenomena with few errors, and present arguments and evaluations clearly c) critically evaluate statements, conclusions or data d) successfully carry out appropriate calculations specified for A Level; apply relevant statistical techniques when directed e) successfully translate data presented as prose, diagrams, drawings, tables or graphs from one form to another f) select a wide range of facts, principles and concepts from both the AS and the A2 specifications g) link together appropriate facts, principles and concepts from different areas of the specification.	Candidates characteristically: a) devise and plan experimental and investigative activities, selecting appropriate techniques b) describe safe and skilful practical techniques c) know how to make observations and measurements with appropriate precision and record these methodically d) interpret, explain, evaluate and communicate the results of experimental and investigative activities, in appropriate contexts e) use an appropriate statistical technique to assess the validity of a hypothesis.
E/U boundary performance descriptions	Candidates characteristically: a) recall some facts and principles from the A2 specification b) show understanding of some principles from the A2 specification c) select some relevant information from the A2 specification d) present information using basic scientific terminology from the A2 specification.	Candidates characteristically: a) apply given principles or concepts in familiar and new contexts involving a few steps in the argument b) describe, and provide a limited explanation of, trends or patterns shown by complex data presented in a variety of forms c) when directed, identify inconsistencies in conclusions or data d) carry out straightforward calculations specified for A Level with partial success; apply a given statistical technique correctly e) in some contexts successfully translate data from one form to another f) select some facts, principles and concepts from both the AS and the A2 specifications g) put together some facts, principles and concepts from different areas of the specification.	Candidates characteristically: a) devise and plan some aspects of experimental and investigative activities b) describe safe practical techniques c) know how to make observations and measurements and record them d) interpret, explain and communicate some aspects of the results of experimental and investigative activities, in appropriate contexts e) use a given statistical technique.

B Spiritual, Moral, Ethical, Social and other Issues

Environmental Studies offers a wide range of opportunities for the exploration of spiritual, moral, ethical and social issues. This specification includes a range of interconnected themes which allow teachers and candidates to explore the implications. Candidates are encouraged to understand and discuss the implications of decisions that may influence many communities, populations and individuals. Within the units, specific references are made to links with spiritual, moral, ethical and social issues; however, implicit in much of the work is the recognition that environmental decisions often have moral, ethical and social parameters.

For example

- social and ethical issues involved in the use of and the demand for water and energy
- the socio-economic effects of land management strategies
- ethical, spiritual and moral reasons for wildlife and wilderness conservation and strategies and methods for enhancing the environment for amenity use
- ethical considerations involved in production systems
- ethical and moral considerations involved in genetic engineering
- moral, ethical and social issues involved in raising the awareness of the community to pollution issues

During the study of this specification, candidates are introduced to

- the profound effect that human activities have on the environment, and hence on its ability to support life and the quality of that life
- the fact that many economic, political and other systems operate with little reference to, or regard for, the importance of the Earth's natural life-support systems and their fragility
- the concept that a choice which increases the material standards for one person may decrease the quality of life for others
- the fact that examples set by an individual or organisation can influence the activities of others
- the range of attitudes that exist, from the purely utilitarian of personal gain to the spiritual-moral with a responsibility for protecting the environment and all its inhabitants for the present and future

European Dimension

AQA has taken account of the 1988 Resolution of the Council of the European Community in preparing this specification and associated specimen units.

Environmental Education

AQA has taken account of the 1988 Resolution of the Council of the European Community and the Report "Environmental Responsibility: An Agenda for Further and Higher Education" 1993 in preparing this specification and associated specimen units.

Avoidance of Bias

AQA has taken great care in the preparation of this specification and specimen units to avoid bias of any kind.

C Overlaps with other Qualifications

GCE Biology

Biodiversity

Dynamic equilibria of populations

Energy through ecosystems

Chemical element recycling

Ecosystems

GCE Geography

Rivers, floods and management

Food supply issues

Energy issues

Weather, climate and associated hazards

Challenges facing ecosystems

Sustainability issues

Conflicts over using a resource

GCE Physics B

Unit 2 Module 2 Energy and the environment

GCE Science in Society

Transport issues

Radiation-risks and uses

Responding to Global Climate Change

Energy futures

Sustaining the variety of life on Earth

D Key Skills - Teaching, Developing and Providing Opportunities for Generating Evidence

Introduction

The Key Skills Qualification requires candidates to demonstrate levels of achievement in the Key Skills of Communication, Application of Number and Information Technology.

The units for the 'wider' Key Skills of Improving own Learning and Performance, Working with Others and Problem Solving are also available. The acquisition and demonstration of ability in these 'wider' Key Skills is deemed highly desirable for all candidates, but they do not form part of the Key Skills Qualification.

The units for each Key Skill comprise three sections:

- What you need to know
- What you must do
- Guidance.

Candidates following a course of study based on this specification for Environmental Studies can be offered opportunities to develop and generate evidence of attainment in aspects of the Key Skills of:

- Communication
- Application of Number
- Information Technology
- Working with Others
- Improving own Learning and Performance
- Problem Solving.

Areas of study and learning that can be used to encourage the acquisition and use of Key Skills, and to provide opportunities to generate evidence for Part B of the units, are signposted on the next page.

The above information is given in the context of the knowledge that Key Skills at level 3 will be available until 2010 with last certification in 2012.

Key Skills Qualifications of Communication, Application of Number and Information and Communication Technology will be phased out and replaced by Functional Skills qualifications in English, Mathematics and ICT from September 2010 onwards. For further information see the AQA website: **http://web.aqa.org.uk/qual/keyskills/com04.php**

Key Skills Opportunities in Environmental Studies

	Unit 1	Unit 2	Unit 3	Unit 4
Communication				
C3.1a	✔	✔	✔	✔
C3.1b	✔	✔	✔	✔
C3.2	✔	✔	✔	✔
C3.3	✔	✔	✔	✔
Application of Number				
N3.1	✔	✔	✔	✔
N3.2	✔	✔	✔	✔
N3.3	✔	✔	✔	✔
Information Technology				
ICT3.1	✔	✔	✔	✔
ICT3.2	✔	✔	✔	✔
ICT3.3	✔	✔	✔	✔
Working With Others				
WO3.1	✔	✔	✔	✔
WO3.2	✔	✔	✔	✔
WO3.3	✔	✔	✔	✔
Improving Own Learning and Performance				
LP3.1	✔	✔	✔	✔
LP3.2	✔	✔	✔	✔
LP3.3	✔	✔	✔	✔
Problem Solving				
PS3.1	✔	✔	✔	✔
PS3.2	✔	✔	✔	✔
PS3.3	✔	✔	✔	✔

GCE Environmental Studies (2440) 2009 onwards

Qualification Accreditation Number: AS 500/2521/1 - A Level 500/2513/2

To obtain free specification updates and support material or to ask us a question register with Ask AQA:
www.aqa.org.uk/ask-aqa/register

Support meetings are available throughout the life of the specification.
Further information is available at:
http://events.aqa.org.uk/ebooking