Unit title: Environmental Monitoring and Analysis

Unit code: **Y/601/0238**

QCF level: **5**

Credit value: **15**

Aim

This unit provides learners with an understanding of natural environmental cycles and the influence of pollutants on ecosystems. The sources and effects of environmental pollutants together with techniques of sampling and chemical analysis are examined.

Unit abstract

The analysis of the natural environment and the impact of human activity on it are central to this unit. Through studying this unit learners will learn about the environment close to where they live and work, as well as the global systems we all depend on.

Learners will learn how the balance of the natural environment relies on transfer mechanisms to cycle and purify its components. The complex nature of the interactions involved and the influence of pollutants on ecosystems are covered.

The importance of fossil fuel combustion as a source of pollution is studied and the effects on ecosystems assessed.

Following the initial introduction to the natural environment, and the potential pollutants within it, learners will plan and carry out an analysis of appropriate material from a selected site. Learners will assess the suitability of a sampling site and select material for analysis and analytical techniques under guidance from their tutor. This practical study allows for an iterative approach to the development of suitable sampling and analytical procedures.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand how biogeochemical cycles result in the transfer of substances between components of ecosystems

2 Understand the sources and effects of environmental pollutants

3 Be able to apply sampling methods appropriate to an analyte

4 Be able to determine the concentration of analytes in samples.

Unit content

1 **Understand how biogeochemical cycles result in the transfer of substances between components of ecosystems**

Abiotic components of biogeochemical cycles: hydrosphere; lithosphere; atmosphere; soil structure and composition; atmospheric transport; aquatic systems

Mechanisms of substance transfer: water cycle; nutrient cycles (carbon, nitrogen, oxygen, phosphorus, sulfur); non-nutrient transfer; by organic species eg PCBs, DDT, hydrocarbons; metals eg lead, cadmium, mercury

Influences on substance cycling: abiotic components of ecosystems; physical properties and composition of aquatic habitats, soil and air; biotic components of ecosystems; feeding, uptake from soil, assimilation, excretion, decomposition

2 **Understand the sources and effects of environmental pollutants**

Sewage treatment: composition of raw sewage; role and effect of primary, secondary and tertiary treatment processes; typical process equipment

Industrial sources of pollutants: sources of water, air and soil pollutants eg petrochemical processing, power generation, mining, manufacturing

Agricultural sources of pollutants: fertilisers; herbicides; pesticides; animal wastes; methane; cleaning agents

Fossil fuel combustion products: gas, petrol, oil and coal combustion products; environmental impact of carbon, nitrogen and sulfur oxides; photochemical smog

Effect of pollutants on ecosystems: toxicity; bioconcentration; biodiversity effects; viral and bacterial pathogens; acidification; greenhouse effect

3 **Be able to apply sampling methods appropriate to an analyte**

Selection of sampling location: appropriate site eg local, field trip, industrial, agricultural; type of pollutant (water, soil, air); accessibility; health and safety considerations

Design of sampling protocol: protocol related to sample type eg water volume, flow, time, container volume, storage and stabilisation, analyte mobility, analyte stability

Quality control: planning for sampling; random sampling; internal standards

Environmental sampling: implementation of sampling protocol; iterative cycle for improvement

4 **Be able to determine the concentration of analytes in samples**

Planning: selection of analytical technique related to analyte eg pre-treatment, extraction, dissolution, spectrometry, chromatography, titration, electrochemical, voltammetry, fluorescence, chemiluminescence

Determination of analyte concentration: implementation of planned analysis; evaluation of results; alteration of plan; repeat of sampling and analysis

Report on analytical procedure: accuracy; reliability; statistical analysis; suggestions for future work

Maximum permitted levels: related to selected analyte eg total organic carbon, nitrate, nitrite, ammonia, biochemical oxygen demand, pH, particulates, suspended solids, heavy metals

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	**Assessment criteria for pass** The learner can:
LO1 Understand how biogeochemical cycles result in the transfer of substances between components of ecosystems	1.1 discuss the abiotic components of biogeochemical cycles 1.2 explain mechanisms by which substances are transferred between environmental components 1.3 explain the abiotic and biotic factors that influence the cycling of substances
LO2 Understand the sources and effects of environmental pollutants	2.1 explain the key stages in sewage treatment 2.2 analyse industrial processes as sources of pollutants 2.3 compare agricultural processes as sources of pollutants 2.4 discuss the environmental impact of fossil fuel combustion products 2.5 assess the effects of selected pollutants on ecosystems
LO3 Be able to apply sampling methods appropriate to an analyte	3.1 select a suitable location for sampling 3.2 design a sampling protocol for specified analytes at a location 3.3 implement quality control criteria for a sampling regime 3.4 carry out appropriate environmental sampling, using safe practices
LO4 Be able to determine the concentration of analytes in samples	4.1 plan analyses appropriate for a specified analyte 4.2 determine the concentration of an analyte in a sample 4.3 report on the accuracy of the results of an analytical procedure 4.4 relate the concentration of an analyte to the maximum permitted levels.

Guidance

Links

This unit has particular links with the following units within this qualification:

- *Unit reference number F/601/0220: Analysis of Scientific Data and Information*
- *Unit reference number K/601/0289: Environmental Management and Conservation.*

Essential requirements

Delivery

Learning outcome 1 covers the complexity of the natural environment and natural material cycles. The nature of soil types including acid-base character and ion exchange effects must be stressed.

Learning outcome 2 can be achieved through case studies and industrial visits. Flow diagrams for the selected industrial or agricultural process, with quantification of the potential pollutant and waste flows, could be produced before the visit to provide a greater appreciation of the emphasis on environmental protection in modern industrial processes. Learners in industry must be encouraged to investigate environmental protection measures at their place of work.

Learning outcomes 3 and 4 are essentially practical and could be delivered using a project-based approach. The intention is to follow a given analysis from selecting an appropriate site through planning sampling regimes to applying suitable chemical analysis to provide an accurate and reproducible result. If group work is used, tutors must ensure that each individual learner provides sufficient evidence of meeting the assessment criteria on an individual basis. Learners may be guided in selecting an appropriate analyte depending on the analytical facilities available at the centre.

Visits to commercial analytical laboratories would be useful in allowing learners to observe quality control systems in practice and appreciate the issues raised by a delay between sampling and analysis.

Assessment

Learning outcome 1 involves the general principles of biogeochemical cycles and as with learning outcome 2, evidence could be generated from case studies.

Learning outcomes 3 and 4 involve planning and practical work and could be suitable for group or individual projects.

Resources

Learners will need access to appropriate laboratory facilities and technical support. The apparatus and instrumentation required will depend on local resources and the analytical methods chosen. Suitable local sampling sites should be identified to support laboratory work. General library facilities, including internet access, will also be needed. Relevant periodicals would be beneficial for resource-based research work.

Employer engagement and vocational contexts

Learners would benefit from visits to industrial settings where effluent treatment and environmental monitoring can be observed. Visits would enable learners to appreciate how reducing environmental impact is central to modern industrial design and processing.

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